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FOSSIL ANTHROPOIDS

YALE-CAMBRIDGE INDIA EXPEDITION OF 1935

GREGORY

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FOSSIL ANTHROPOIDS OF THE YALE-CAMBRIDGE INDIA EXPEDITION OF 1935

By

WILLIAM K. GREGORY
MILO HELLMAN
G. EDWARD LEWIS

Published by Carnegie Institution of Washington
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FOSSIL ANTHROPOIDS OF THE YALE-CAMBRIDGE INDIA EXPEDITION OF 1935

INTRODUCTION

The Yale-Cambridge India Expedition of 1935, under the direction of Dr. H. de Terra, secured from several localities in the Siwalik hills a small but valuable collection of fossil ape teeth and parts of jaws; these prove to be of considerable importance, especially when added to the collections of the Yale North India Expedition of 1931–1933. Through the kindness of the Director of the Geological Survey of India, a small collection of Siwalik anthropoid teeth in the Indian Museum, Calcutta, has been loaned to us for study and description. Accurate casts of the type specimens of Lydekker's and Pilgrim's species were supplied by the same institution, and we are also indebted to the Prince of Wales College Museum at Jammu for the loan of the third lower molar described below (p. 18).

At the Peabody Museum, Yale University, the junior author was assisted in the preparation of the photographic negatives of plates 1, 2 figures 1–3, and 3 figures 1–7 by Mr. F. C. Herpich, who in addition kindly proffered the use of his personal equipment. The remaining figures of plates 2 and 3, together with plates 4–8, were made from enlarged photographs by Mr. Julius Kirschner, of the American Museum. We are indebted to Dr. J. C. Merriam and Dr. H. de Terra for the opportunity of studying and describing the present material.

Up to the present time the number of supposed genera and species of fossil apes from India has been increasing with every new collection, but, notwithstanding our several previous studies, the interrelationships of these forms have for the most part been pretty dubious. It was apparent that, taking them as a whole, the range of differences in size, form, and details of molar patterns was great, and that in these scattered fragments there is evidence of a wide genetic radiation of the anthropoids in the region of what is now the Siwaliks. All the numerous species described by previous authors (Lydekker, Pilgrim, Brown, Gregory and Hellman, Lewis) rested on parts of either the upper or the lower jaw and teeth, and in no case has the holotype included definitely associated upper and lower teeth. The same is also true of the European species of *Dryopithecus* and allied genera. It was our hope that the new collections would enable us to make at least a beginning in correlating the upper with the lower teeth and in reducing some of the "species" to the rank of synonyms. Fortunately they have indeed made possible some progress in this direction and at the same time have supplied evidence relating to the phylogenetic sequence of certain species.

Since the general problem of the Siwalik anthropoids is being dealt with in a monograph by G. E. Lewis, the present paper deals only with the material collected by the Yale-Cambridge Expedition of 1935. A brief synopsis of the nomenclature and synonymy of the Siwalik anthropoids, published by Lewis in August 1937, explains the great complexity of the nomenclatural problem and the reasons for reducing several widely used names (e.g., *Dryopithecus cautleyi*) to the rank of synonyms.

The stratigraphic sequence and faunas of the Siwalik deposits having been described recently by Colbert (1935), by de Terra and Teilhard de Chardin (1936), and by Lewis (1937), we need say here only that in a general way the Siwalik fossil apes range from the uppermost middle Miocene to the middle Pliocene. Between the successive zones there is not always a sharp faunal break, at least in the anthropoid series. This accords with much evidence tending to show that in spite of their great thickness the older Siwalik deposits were built up during a relatively short period of rapid sedimentation.

LIST OF SPECIMENS WITH PROVISIONAL DETERMINATIONS

By agreement between the museums concerned, the primate material described below has been divided between the Peabody Museum of Yale University and the Indian Museum in Calcutta, as shown in the table on pages 3 and 4. The new specimens were collected mostly by Mr. Aiyengar.

We have, of course, also restudied the specimens described by Lewis in 1934 and by Gregory and Hellman in 1926.

COMPARATIVE MEASUREMENTS OF SIWALIK ANTHROPOID TEETH

Since the degree of wear greatly affects the dimensions and proportions of the teeth, especially in the lower molars, we have prepared the following classification with reference to stage of wear:

I. *Unoccluded.* No pressure or occlusal wear facets; enamel sculpture unaltered. Unerupted or just erupted.
II. *Early post-eruptive.* Cusps show occlusal wear facets; proximating surfaces of adjacent teeth show pressure facets; enamel sculpture showing some wear but still preserved.
III. *Moderate.* All enamel sculpture worn away except primary sulci indicating groove pattern ("*Dryopithecus*," "cruciform," etc.); no dentine exposed; pressure facets shown.
IV. *Advanced.* Enamel worn away in places, forming pits in end, localized by the primary cusp points of underlying dentine; primary sulci still preserved; cusps still retain their identity at their bases; pressure facets shown.
V. *Extreme.* Cusps and groove pattern obliterated; pressure facets pronounced; entire crown ultimately worn away on occlusal surface.

	I. To the Geological Survey of India			II. To Yale University	
No. 618 C-48	*Ramapithecus* cf. *brevirostris* ramus, 4 good teeth *Horizon*: Uppermost Chinji *Locality*: Kundal Nala, Chinji	$P\overline{3}$ $P\overline{4}$ $M\overline{1}$ $M\overline{2}$	$P\overline{4}$ $M\overline{1}$ $M\overline{2}$ $M\overline{3}$	*Sivapithecus indicus* ramus, 4 good teeth *Horizon*: Chinji *Locality*: ¼ mi. E. Hari Talyangar	Y.P.M. 13828
No. 617	*Sivapithecus sivalensis* (*Dryopithecus cautleyi*) 5 perfect crowns (goes with K 29/466 r. $C\underline{1}$, l. $C\underline{1}$, l. $P\underline{4}$, r. $M\underline{1}$, l. $M\underline{2}$) *Horizon*: Chinji *Locality*: Hari Temple Scarp E. of Hari Talyangar	r. $P\underline{3}$ l. $P\underline{3}$ l. $M\underline{1}$ r. $M\underline{2}$ r. $M\underline{3}$	$P\underline{3}$ $P\underline{4}$ $M\underline{2}$	*Sivapithecus indicus* 1 perfect crown ½ broken crown *Horizon*: Chinji *Locality*: ¾ mi. SE. Hari Talyangar	No. 616 Y.P.M. 13837
			$M\underline{1}$	"*Sivapithecus*" cf. *indicus* perfect crown *Horizon*: Chinji *Locality*: Chinji	No. 612 Y.P.M. 13834
			$M\underline{2}$	*Sivapithecus indicus* perfect crown *Horizon*: Chinji *Locality*: Chinji	No. 613 Y.P.M. 13835
No. 601	*Sugrivapithecus* cf. *salmontanus* 1 perfect crown *Horizon*: Chinji *Locality*: SW. Ramnagar, Kashmir	$M\overline{1}$	$M\overline{2}$	*Sivapithecus sivalensis* perfect crown *Horizon*: Chinji *Locality*: SW. Ramnagar	No. 600 Y.P.M. 13832
No. 602	*Sugrivapithecus* cf. *salmontanus* 1 perfect crown *Horizon*: Chinji *Locality*: SW. Ramnagar	$M\overline{1}$	$M\overline{3}$	*Bramapithecus* cf. *punjabicus* perfect crown *Horizon*: Chinji *Locality*: 2 mi. NE. Kanatti	No. 609 Y.P.M. 13833
No. 610	*Sugrivapithecus* cf. *salmontanus* worn crown *Horizon*: Chinji *Locality*: 1 mi. S. Parrewali	$M\overline{1}$	$M\overline{3}$	*Sugrivapithecus* cf. *gregoryi* weathered crown *Horizon*: Chinji *Locality*: Chinji	No. 607 Y.P.M. 13836

(*Continued on page* 4)

(*Continued from page* 3)

No. 603	*Sivapithecus indicus* badly worn *Horizon*: Chinji *Locality*: Near Ramnagar	$M\underline{2}$	$M\underline{2}$ $M\overline{1}$	*Sivapithecus* sp. more than half of crown broken off *Horizon*: Chinji *Locality*: 1½ mi. NE. Kanatti	No. 615 Y.P.M. 13831
No. 614	*Sivapithecus sivalensis* weathered *Horizon*: Chinji *Locality*: Kundal Nala, Chinji	$M\underline{1}$			
No. 611	*Sivapithecus indicus* slightly weathered *Horizon*: Chinji *Locality*: 1 mi. SW. Chinji	$M\overline{3}$			
No. 621	621A, may be anthropoid 621B, indeterminate 621C, indeterminate *Horizon*: Chinji *Locality*: Hari Talyangar, Hari Scarp	C ? C ? I			

III. SPECIMENS LOANED TO US BY THE INDIAN MUSEUM

K 29/466	r. $C\underline{1}$, l. $C\underline{1}$, l. $P\underline{4}$, r. $M\underline{1}$, l. $M\underline{2}$	*Sivapithecus sivalensis*
K 22/488	r. $C\underline{1}$	*Sivapithecus indicus*
K 23/212	l. $C\underline{1}$	*Sivapithecus sivalensis*
K 23/740	r. $M\underline{3}$	*Sivapithecus indicus*
K 23/209	r. $M\underline{2}$	*Sivapithecus* ? sp. (Kamlial)
Jammu *	l. $M\overline{3}$	*Sivapithecus* cf. *darwini*

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* This specimen was loaned by the Prince of Wales College Museum at Jammu.

In general, differences in measurements and indices are significant as specific and generic characters inversely as the range of variability. For example, in the diameters of female canines in orangs we may have an extremely wide range; the anteroposterior measurement of the M3 is also highly variable in recent apes and man. At the other extreme, the breadth index of M1, while relatively small, seems to be of high specific value.

The principal measurements of specimens herein adopted are as follows:

Table 1 *

SYNOPSIS OF CONTRASTS IN LOWER MOLARS OF SIWALIK ANTHROPOIDS

TYPE	M_1			M_2			M_3			REMARKS	MANDIBLE (beneath M_2)
	ap.	tr.	br.ind.	ap.	tr	br.ind.	ap.	tr.	br.ind.		
Dryopithecus fontani	9·6 -10·6	8 6 - 9	**83 -90**	10·5 -12	9·3 -11·9	**85·5 -100**	11·5 -12·5	9 4 -10·5	**78·3 -84**	Size and proportions variable.	Very deep
“ “	10	8·8	**88**	11	10	**90·9**	11·5	10	**86·9**	M_{1-3} all small, of moderate proportions, cusps delicate.	“
“ average	10·1	8·9	**88**	11·3	10·3	**90**	11·7	9·7	**83**		
Sivapithecus sivalensis	10·6	9·5	**90**	11·6	11·4	**98·3**	13·7	12·3	**90**	M_1, M_2 increaing in size and relative width; M_3 large, elongate, oval, talonid widening; M_2 with prominent hypoconulid	Deep
“ *indicus*	11·5	10·5	**91**	13·3	12·3	**92·4**	13·8	12·7	**92**		
“ “	12·4	11·8e	**95e**	14·5	13·7	**93**	15·8	13·6	**84·8**		
“*Sivapithecus indicus*”	11·5	10·6	**92**	13	12·3	**95**	—	—	—	Close to *frickae* in proportions but M_2 looks wider and “squarish”; cusps low, very round; M_2 with hypoconulid not prominent.	“
Ramapithecus cf. *brevirostris* (618)	9·1	8·1	**89**	10·2	9	**89·2**	—	—	—	Molars very small; M_1, M_2 of intermediate proportions.	Shallow and thin
Bramapithecus thorpei	—	—	—	10	10·6	**106**	11·1	10·5	**95**	M_2 very short and wide (across trigonid) M_3 short; talonid short.	Shallow
“ *punjabicus*	—	—	—	11·3	10	**88·5**	12·8	10·6	**83**	M_2, M_3 of intermediate proportions; crowns resemble *B. thorpei* except in proportions, lingual faces flattened.	“
“ “ (609)	—	—	—	—	—	—	13·7	11·9	**86·1**		
“*Dryopithecus*” cf. *darwini*	—	—	—	—	—	—	13	12	**92·3**	M_3 broad oval, like *thorpei* but larger and not so short; like M_3 of *cautleyi* but shorter.	—
“ *sivalensis*	—	—	—	10·5	10	**95**	11	8·6	**78**	M_2 short, M_3 small, with narrow trigonid and talonid.	Shallow and thick
Sugrivapithecus salmontanus	11	9 1	**82·7**	12·6	10·5	**83**	—	—	—	Molars long and very narrow; M_3 with narrow oval talonid.	Shallow
“ *gregoryi*	11·1	9	**81**	12·6	9·9	**78·6**	—	—	—		
“ (?) “ (607)	—	—	—	—	—	—	12·8	10·2	**79**		
Neopithecus brancoi	—	—	—	—	—	—	10·8	8	**74·1**	M_3 small, extremely narrow.	—

DFLB

* Sixth line from bottom should read *Sivapithecus* cf. *darwini*. Fifth line from bottom should read *Bramapithecus* ? *sivalensis*.

Incisors

1. Mesio-distal: the greatest dimension at the incisal edge.
2. Labio-lingual: the greatest distance between the labial and lingual convexities of the crown near the neck of the tooth.

Canines

1. Mesio-distal: the greatest distance between the tubercles at the bases of the cutting edges running from the cusp points to the neck.
2. Labio-lingual: the minimum transverse dimension at the region of maximum girth.

Cheek teeth

$\mathrm{P}\overline{3}$ (This tooth varies from an anteroposterior to a nearly transverse position.)

1. Mesio-distal (ap.):[1] the maximum dimension at the region of greatest girth.
2. Labio-lingual (tr.): the minimum dimension at the region of greatest girth.

$\mathrm{P}\underline{3}$ (This tooth is triangular.)

1. Mesio-distal: the greatest dimension on the labial side.
2. Labio-lingual: the greatest dimension at the region of maximum girth.

$\mathrm{P}\overline{4}$–$\mathrm{M}\overline{2}$, $\mathrm{P}\underline{4}$–$\mathrm{M}\underline{2}$

1. Mesio-distal (ap.): the greatest dimension between proximating surfaces.
2. Labio-lingual (tr.): the greatest dimension at the region of maximum girth.

$\mathrm{M}\overline{3}$, $\mathrm{M}\underline{3}$

1. Mesio-distal (ap.): the greatest dimension between the anterior proximating surface and the posterior maximum convexity.
2. Labio-lingual (tr.): the greatest dimension at the region of maximum girth.

DESCRIPTION OF MATERIAL

Sivapithecus sivalensis (Lydekker)

(Plates 1, figures 1–8; 2A–E; 4; 5A)

Palæopithecus sivalensis Lydekker, Rec. Geol. Surv. India, vol. 12, 33, figs. 1, 5, 1879.

Troglodytes sivalensis, Lydekker, Mem. Geol. Surv. India, Pal. Indica (10), vol. 4, part 1, suppl. 1, p. 2, 1886.

Dryopithecus cautleyi, Brown, Gregory and Hellman, Amer. Mus. Novitates, No. 130, Sept. 22, 1924; Gregory and Hellman, Anthropol. Papers Amer. Mus. Nat. Hist., vol. 28, part 1, 1926.

Generic reference—In 1926 we provisionally referred the then "new species" *cautleyi* to the genus *Dryopithecus*, concluding, however (p. 84), that "on the whole, the Indian '*Dryopithecus*' seems to be allied rather with the orang than with the gorilla-chimpanzee-man group, the former constituting an eastern, the latter a western, division of the family Simiidæ." We also stated that "*D. frickæ* and *D. giganteus* may be related species of a subgenus allied with *Palæopithecus* and with *Sivapithecus*." For reasons that will be stated below it now seems advisable to remove *Dryopithecus cautleyi* from the genus *Dryopithecus* and to assign it to the genus *Sivapithecus* as a synonym of the species *sivalensis* Lydekker.

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[1] It will be noted that especially in our tables we retain the well-known and convenient abbreviations ap. and tr. for the molars and premolars, but use m.d. and l.l. for the canines.

Lewis (1937) follows Palmer (1904, p. 503) in rejecting the name *Palæopithecus* for a Siwalik anthropoid as invalid, because it was used by Voigt

TABLE 2—*Comparative measurements of Siwalik anthropoid teeth*

$\mathrm{C}\overline{1}$

	m.d.	l.l.	ind.
Sivapithecus sivalensis, type	8.5	10.6	124.7
Dryopithecus cautleyi, type	8.4	10.7	127.4
Dryopithecus fontani (Harlé)	11.0		
Dryopithecus fontani (cast)	9.0	10.8	120.0
"*Sivapithecus indicus*" (cast)	10.6	14.2	135.0

$\mathrm{P}\overline{3}$

	ap.	tr.	ind.
Sivapithecus indicus			
Dryopithecus cautleyi, type	11.3	7.5	66.3
Ramapithecus cf. *brevirostris*, No. 618	9.5	5.4	57.0

$\mathrm{P}\overline{4}$

	ap.	tr.	ind.
Sivapithecus indicus, Y.P.M. 13828, Nagri	9.1	11.5	126.0
Sivapithecus indicus (Pilgrim)	8.5	11.2	132.0
Ramapithecus cf. *brevirostris*, No. 618	6.0	6.9 e	115.0 e
Dryopithecus cautleyi, type	7.8	9.2	118.0

e=estimated.

$\mathrm{M}\overline{1}$

				Trigonid		Talonid		Height	Stage
	ap.	tr.	ind.	tr.	ind.	tr.	ind.	me^{d}	of wear
Dryopithecus fontani (average)	10.1	8.9	88.0						
Sivapithecus sivalensis:									
Dryopithecus cautleyi, type, Nagri	10.6	9.5	90.0	9.5	90.0	9.3	88.0	6.4	IV
Y.P.M. 13813	10.8	9.8	91.0	9.4	87.0	9.0	83.0	6.4	I
Dryopithecus frickæ, type, Dhok Pathan	11.5	10.5	91.0	10.3	89.0	11.0	96.0		IV
Sivapithecus indicus:									
Sivapithecus himalayensis, type, Nagri	11.8	10.9	92.0						III
Y.P.M. 13828, Nagri	12.4	11.8 e	95.0 e	11.8 e	95.0	11.6	93.5	7.3 e	IV
Sugrivapithecus salmontanus, type, Nagri	11.0	9.1	82.7	9.0	81.8	9.1	82.7	6.5	III
Sugrivapithecus cf. *salmontanus:*									
No. 601, upper Chinji	11.1	9.4	84.6						II–III
No. 602, upper Chinji	11.0	9.1	82.7	9.2	83.0	9.0	82.0	5.2	IV
Sugrivapithecus gregoryi, type, Nagri	11.1	9.0	81.0	9.0	81.0	8.9	80.0	6.0	III
Sivapithecus sp.	11.5	10.6	92.0						IV
No. 615 (Y.P.M. 13831)	11.5								IV
Ramapithecus cf. *brevirostris*, No. 618 (much worn), upper Chinji	9.1	8.1	89.0	7.5	82.0	8.1	89.0		IV–V

Table 2—*Comparative measurements of Siwalik anthropoid teeth*—Continued

M2

	ap.	tr.	ind.	Trigonid tr.	Trigonid ind.	Talonid tr.	Talonid ind.	Height me^{d}	Stage of wear
Dryopithecus fontani (average)	11.3	10.3	90.0						
Sivapithecus sivalensis:									
Dryopithecus cautleyi, type, Nagri	11.6	11.4	98.3	11.3	89.7	11.2	88.9	6.6	III
Dryopithecus frickæ, type, Dhok Pathan	13.3	12.3	92.4	12.3	91.1	12.0	88.9	8.1	III
				12.1	93.0	11.8	90.0		
Sivapithecus indicus:									
Sivapithecus himalayensis, type, I.M. D 119, Nagri	15.1	14.2	91.0						II–III
	(cast)	13.7*							
Y.P.M. 13828, Nagri	14.5	13.7	93.0	13.7	93.0	13.6	93.8	7.8	III
"*Sivapithecus*" *middlemissi,* I.M. D 198, Chinji	12.9	12.3	95.0						V
"*Sivapithecus indicus*" mandible, Chinji	13.0	12.3	95.0						III
Sugrivapithecus salmontanus, type, Nagri	12.6	10.5	83.0	10.5	83.3	10.4	82.6	7.0	II–III
Sugrivapithecus gregoryi, type, Nagri	12.6	9.9	78.6	9.9	78.6	9.6	76.2	5.9	III
Bramapithecus punjabicus:									
Dryopithecus punjabicus, type (cast), Chinji	11.3	10.0	88.5	10.0	88.5	9.4	83.2		IV
Bramapithecus ? sivalensis, type	10.5	10.0	95.0						IV
Ramapithecus cf. *brevirostris,* No. 618, upper Chinji	10.2	9.0	89.2	9.0	89.2	9.0	89.2		IV
Bramapithecus thorpei, type, upper Chinji	10.0	10.6	106.0	10.6	106.0	10.0	100.0		IV–V

* Pilgrim's tr., probably across trigonid only (?).

M3

	ap.	tr.	ind.	Trigonid tr.	Trigonid ind.	Talonid tr.	Talonid ind.	Height me^{d}	Stage of wear
Dryopithecus fontani (average)	11.7	9.7	83.0						
Sivapithecus sivalensis:									
Dryopithecus cautleyi, type, Nagri	13.7	12.3	90.0	12.3	90.0	11.0	80.0	7.4	II
Dryopithecus frickæ, type, Dhok Pathan	13.8	12.7	92.0	12.6	90.0	11.0	78.6	8.3	III
Sivapithecus indicus:									
Y.P.M. 13828, Nagri	15.8	13.4	84.8	13.4	85.0	13.0	82.0	7.7	III
"*Sivapithecus*" *middlemissi,* Chinji	14.4	13.2	92.0						IV–V
"*Sivapithecus indicus*" mandible, Chinji	14.3	13.4	93.7						III
Sivapithecus cf. *darwini,* upper Chinji	13.0	12.0	92.3	12.0	92.3	11.2	86.0	6.6	II
Dryopithecus darwini, type (cast)	13.5	12.4	92.6						II
Sugrivapithecus cf. *gregoryi,* No. 607, lower Chinji	12.8	10.2	79.0	10.2	79.0	9.0	70.0		III
Bramapithecus punjabicus:									
Dryopithecus punjabicus, type (cast), Chinji	12.8	10.6	83.0	10.3	81.0	10.2	80.0	6.5	III
Bramapithecus cf. *punjabicus,* No. 609, upper Chinji	13.7	11.9	86.1	11.9	86.1	10.0	73.0	7.3	III
"*Dryopithecus*" (*Bramapithecus ?*) *sivalensis,* Nagri	11.0	8.6	78.0	8.6	78.0	8.2	75.0	5.2	IV
Bramapithecus thorpei, type, upper Chinji	11.1	10.8 10.5	97.0	10.6	96.0	9.5	85.6	6.2	III–IV

TABLE 2—*Comparative measurements of Siwalik anthropoid teeth*—Continued

C1

	m.d.	l.l.	ind.	ant.
Sivapithecus sivalensis:				
K 29/466 l., Nagri	11.0	10.4	94.5	14.7
		min. 7.9		
K 29/466 r., Nagri	11.1	10.4	93.7	14.6
		min. 8.0		
K 23/212 l., Chinji	12.5	8.6	68.8	
Sivapithecus indicus:				
Sivapithecus himalayensis, type, r., Nagri	14.7	12.3	83.7	
K 22/448 r., (?)Chinji	15.0	10.8	72.0	

P3

	ap.	tr.	ind.	ant.	Max. ht. (buccal)
Sivapithecus sivalensis:					
No. 617 l., Nagri	8.7	11.1	127.0	10.4	5.6
No. 617 r., Nagri	8.7	10.9	125.0		5.6
Sivapithecus indicus, No. 616 (?)Nagri	8.9	11.3	127.0	12.5	5.6

P4

	ap.	tr.	ind.	ant.	Max. ht. (buccal)
Sivapithecus sivalensis, K 29/466 l., Nagri	7.6	11.4	150.0	8.7	5.0

M1

	ap.	tr.	Trigonid ap.	ind.	tr. hy to me base	Height * crown (labial)	tr.† pr to pa	Stage of wear
Sivapithecus sivalensis:								
Palæopithecus sivalensis, type (cast), Dhok Pathan	10.9	12.5		114.7				
No. 614, Chinji	10.3	12.1	11.8	117.0	11.4		11.4	III
No. 617, Nagri	10.7	12.2	12.2	114.0	12.0	6.5	6.5	III
K 29/466, Nagri	10.5	12.2	11.9	113.0	12.3	7.3		III
Sivapithecus indicus:								
Sivapithecus orientalis, type, Pilgrim, Nagri	11.0	12.0		109.0				
Sivapithecus cf. *indicus,* No. 612 (Y.P.M. 13834), Chinji	11.3	12.4	12.5	109.0	12.2	8.2		
Sugrivapithecus cf. *salmontanus:*								
"Dryopithecus punjabicus," I.M. D 185, Nagri	10.4	11.3		109.0				
Dryopithecus germanicus (cast), Bohnerz, upper Pontian	9.6	10.0		104.0				
Ramapithecus brevirostris, type, Nagri	9.2	10.9		119.0				

* Measured from plane connecting summit pa and me to basal enamel margin.

† Cusp points.

TABLE 2—*Comparative measurements of Siwalik anthropoid teeth*—Continued

$\mathrm{M}\underline{2}$

	ap.	tr.	Trigonid tr.	ind.	tr. hy to me	Height crown	tr. pa to me	Stage of wear
Sivapithecus sivalensis:								
Palæopithecus sivalensis, type (cast), Dhok Pathan	12.0	13.1		109.1				
No. 617, Nagri..........	11.4	13.6	13.6	119.0	12.8	7.5	6.5	
K 29/466, Nagri.........	11.6	13.7	13.7	118.0	12.6	8.0	5.5	
Sivapithecus indicus:								
Sivapithecus orientalis, type, Nagri	12.8	14.2		111.0				
No. 613, upper Chinji....	12.7	15.5	15.5	122.0	13.8	7.3		III
No. 616, (?)Nagri........	13.3	15.3	15.3	115.0	14.2	8.8	6.6	II
Dryopithecus germanicus, Bohnerz, upper Pontian.	10.4	11.0		106.0				
Sugrivapithecus cf. *salmontanus:*								
"*Dryopithecus punjabicus,*" Nagri	10.6	11.4		107.0				
Ramapithecus brevirostris, type, Nagri	9.9	11.9		120.0				

$\mathrm{M}\underline{3}$

	ap.	tr.	Trigonid tr.	ind.	tr. hy to me	Height crown	tr. pa to me	Stage of wear
Sivapithecus sivalensis:								
Palæopithecus sivalensis, type(cast), Dhok Pathan	10.4	11.4		109.6				
No. 617, Nagri...........	11.0	13.0	13.0	118.0	10.6	6.3	4.7	
Sivapithecus indicus:								
Sivapithecus orientalis, type, I.M. D 196.......	12.4	13.2		105.5				
K 23/740, (?)Nagri......	12.5	13.1	12.9	104.0	10.0	5.7	7.0	
Palæosimia rugosidens, type, (?)Chinji	10.8	11.9		110.0				

in 1835 for the well-known Triassic reptilian footprints which were later called *Chirotherium.* Apparently the first valid, available generic name for *Palæopithecus sivalensis* Lydekker is *Sivapithecus* Pilgrim, 1910. (See Lewis, 1937.)

Generic characters—Siwalik Simiidæ with moderately large and advanced upper and lower molar crowns, incipiently hypsodont with relatively steep and flat lingual and buccal slopes. Breadth indices of upper molars moderate to high, of lower molars intermediate between the low indices of *Sugrivapithecus* and the high indices of *Bramapithecus* (see tables 1, 2). Upper canines in males either massive, with posterior shear and deep anterior vertical groove, or more slender with less accented characters; in females, sub-premolariform, with low tips, strong internal cingulum, and incipient basal cusp. Male mandible, beneath $\mathrm{M}\overline{1}$ and $\mathrm{M}\overline{2}$, not so deep as in European *Dryopithecus*; $\mathrm{M}\overline{2}$ typically larger and wider, lower molar cusps more massive, external cingula absent.

Specific synonymy—The specific name *cautleyi* is very probably a synonym of *Palæopithecus sivalensis* Lydekker, 1879. The holotype of the latter is a badly worn and incomplete set of upper teeth, the basis of Lydekker's later figure of the palate (Mem. Geol. Surv. India, pl. 1, figs. 1, 1*a*, 1886). The type is believed to have come from the Dhok Pathan. Through the courtesy of the Director of the Geological Survey of India we have received a cast of the left maxilla and cheek teeth of the type. Owing to the incompleteness and extreme wear of the teeth, the surface features of the crowns are largely absent. Nevertheless the general forms agree well with those of the upper teeth, No. 617 described below, which we are therefore referring to *sivalensis* (Lydekker). Even as it stands this upper set would almost fit the lower teeth of the type of *Dryopithecus cautleyi*, as shown by careful study of the distances between various cusp points. For these reasons we are treating the species *cautleyi* as a synonym of *sivalensis*.

Specific characters—Lower molars intermediate in size between those of *Dryopithecus fontani* and *Sivapithecus indicus*; breadth index rising sharply from M$\overline{1}$ to M$\overline{2}$, falling again to M$\overline{3}$; M$\overline{1}$ intermediate or moderate in breadth, with small hypoconulid (cusp 5); M$\overline{1}$, M$\overline{2}$ increasing in size and markedly in relative width; M$\overline{2}$ (relatively wide in type) with small hypoconulid, fovea posterior small, crossed by anteroposterior groove; M$\overline{3}$ large, elongate oval, with moderately wide talonid and well-developed hypoconulid and entoconid, a small cusp 6, external cingula vestigial or absent; buccal and lingual cusps of moderate convexity. Upper molars with relatively large and wide M$\underline{2}$, cusps well rounded, of moderate height, internal cingula absent, unworn crowns but little wrinkled; hypocone projecting markedly backward on M$\underline{2}$, not on M$\underline{3}$; M$\underline{3}$ with anteroposterior groove beginning to notch crista obliqua (metaconule-metacone ridge) but not extended forward across central valley; posterior cingulum wall of M$\underline{3}$ somewhat beaded, not extending far backward.

New material—The 1935 expedition yielded the following specimens, which are provisionally referred to this species:

Number	Horizon	Specimen	Measurements ap.	Measurements tr.	Plate	Index	Stage of wear
617.........	Nagri	l. P$\underline{3}$	8.7	11.1		127.0	II
		r. P$\underline{3}$	8.7	10.9	1, figs. 2*a*, 2*b*	125.0	II
		l. M$\underline{1}$	10.7	12.2	1, figs. 4*a*, 4*b*	114.0	III
		r. M$\underline{2}$	11.4	13.6	1, figs. 8*a*, 8*b*	119.0	I–II
		l. M$\underline{3}$	11.0	13.0	1, fig. 6	118.0	I
K 29/466....	Nagri	r. $\underline{C}$	11.1	min. 8.0, 10.4			
		l. $\underline{C}$	11.0	min. 7.9, 10.4	1, figs. 1*a*–1*e*		
		l. P$\underline{4}$	7.6	11.4	1, figs. 3*a*, 3*b*	150.0	II
		r. M$\underline{1}$	10.5	12.2	1, figs. 7*a*, 7*b*	113.0	III
		l. M$\underline{2}$	11.6	13.7	1, figs. 5*a*, 5*b*	118.0	I–II
K 23/212....	Chinji	l. $\underline{C}$	12.5	8.6		68.8	
600 (Y.P.M. 13832)....	Chinji	r. M$\overline{2}$	12.6	11.6	3, figs. 3*a*, 3*b*	92.0	II, III

Nos. 617 and K 29/466 all belong to one individual (pl. 4A), although from different collections; the specimen is probably a female of *Sivapithecus sivalensis* with small canines.

No. K 29/466, loaned by the Indian Museum, Calcutta, together with our own material supplies knowledge of almost the entire upper dentition except the incisors, and by means of occlusion of the teeth with those of the type mandibular arch of *Dryopithecus cautleyi* even permits a restoration of the upper dental arch. As thus reconstructed the palate (K 29/466 plus No. 617) will nearly fit the type of *cautleyi*; indeed, it fits better than might be expected from the marked differences in wear of the upper and lower cheek teeth. At first sight the upper M$\underline{3}$ appears definitely too small to fit the lower M$\overline{3}$, but observations on numerous upper and lower jaws of orangs reveals a marked inferiority in length of $M\underline{3}$ as compared with $M\overline{3}$. In any case the occlusal relations between the new palate and the type mandible of *cautleyi* strongly suggest specific identity.

The restoration of the mandible and upper dental arch (pl. 4B, C) was made by one of us (M. H.) according to the following steps:

1. The type of *Dryopithecus pilgrimi* includes the uncrushed, beautifully preserved front end of the mandible; this so closely matches the front part of the lower dentition in the type of *Dryopithecus cautleyi* that the two forms may safely be assumed to be closely related or identical.
2. From these two specimens, the left side and the front end of the lower dental arch being given, the missing parts on the right side were modeled as mirror images of the known parts. This gave the diameters across the canines, premolars, and molars.
3. The several missing upper cheek teeth of No. 617 were modeled as mirror images of their fellows of the opposite side.
4. The individual upper teeth of one side of No. 617 were placed in series, according to the evidence afforded by the interproximal wearing facets.
5. The opposite upper teeth were placed at such transverse distances from their fellows as would allow them to occlude with their antagonists on the restored mandible.
6. A preliminary placing of the upper dental arch having been tried, minor corrections in the positions of the individual teeth were made by a process of trial and error, until all the upper teeth were in correct occlusal relations with their antagonists in the lower jaw.
7. The positions of missing lower incisors were given by their well-preserved roots; the collective width of their crowns was fixed by the known distance between the mesial sides of the opposite canines.

The fact that the palatal arch as thus built up does fit with considerable accuracy on the lower teeth is taken as experimental evidence that the upper and lower teeth belong to the same species.

The upper premolars and molars seem to agree in generic characters with those of the type of *Sivapithecus orientalis* Pilgrim (= *S. indicus*), while the lower cheek teeth agree *generically* with the type of *Sivapithecus himalayensis* Pilgrim, as well as with Pilgrim's original type of *S. indicus* (Ind. Mus. D 177). For this and other reasons we conclude, provisionally at least, that Dr. Pilgrim was correct in referring the types of the species named by him *Sivapithecus himalayensis* and *S. orientalis* to the genus *Sivapithecus*.

The upper and lower canines by their contrast in dimensions correspond to the differences between male and female orangs. The more slender, much worn canine (K 23/212, pl. 2, figs. 1*a*, 1*b*, A, B) occludes very well with the lower canine and anterior premolar of the type of *Dryopithecus cautleyi*.

No. K 29/466, the smallest upper canines (right and left) are associated with right and left upper premolars and molars which we have likewise referred to *sivalensis*. These canines (pl. 1, figs. 1*a*–1*d*; pl. 2C, D, E) have the "premolar characters" greatly emphasized, namely, relatively low tip, marked anterior vertical groove bordered by prominent vertical lingual and buccal ridges, conspicuous internal cingulum culminating in large lingual tubercle, pronounced posterointernal fossa, sharp posterior cutting edge. Nevertheless we tentatively refer this to the same species (*sivalensis*) as the slender crowned canine (K 23/212) because these differences can be closely matched among female orangs (A.M. 19548, 18010).

The "slender" upper canine (K 23/212) has a breadth index of 68.8, while the wide "premolariform" upper canines (K 29/466) have indices of 94.5 and 93.7 respectively. The "massive" upper canine (K 22/448, pl. 2, figs. 2*a*, 2*b*) has an index of 72; that is not much wider relatively than the "slender" upper canine. The tusklike canine of the type of *Sivapithecus orientalis* has an intermediate index, 83.7. Corresponding indices based on Hellman's measurements of twenty-eight female orangs give a range from 45 to 135, with an average of 84.6.

The lower canines, partly preserved in the types of *pilgrimi* and *cautleyi*, are much wider labio-lingually than the upper, as in anthropoids generally. The differences in breadth index (see table 2) between *Sivapithecus sivalensis, Dryopithecus fontani*, and *Sivapithecus indicus*, ranging from 120 to 135, are insignificant when compared with the range in recent orangs (♀ 45–160, ♂ 85–190). Therefore the taxonomic value of the dimensions and proportions of the lower canines, so far as now available, is extremely dubious.

P$\underline{3}$ right and left (No. 617) are associated with M$\underline{1}$, M$\underline{2}$, M$\underline{3}$, all from the Nagri formation. The right and left third upper premolars show marked agreement with each other in form and number of cusps, contour of teeth and crown as a whole, together with differences in detail. On the right side there are two small complete cross ridges (*Leisten* of Remane) between the outer and inner cusps, converting the enclosed area into a deep pit. On the left side the posterior ridge is vestigial and the ridge does not reach across to the inner cusp, leaving a large central fossa instead of a small pit. These differences might at first sight be mistaken for specific differences. Remane (1921) laid great stress on the presence or absence of such accessory *Leisten* in the upper premolars. Very probably, however, these are opposites of the same individual. In other words, individual variability must be taken into account in the future classification of Siwalik and modern anthropoids.

Comparison of upper and lower molars of Sivapithecus sivalensis with those of European species of Dryopithecus—Next arises the question: what are the significant differences between the Siwalik forms here referred to *Sivapithecus* and the European forms named *Dryopithecus fontani* and *D. germanicus?*

The upper molars of *D. fontani* and *D. germanicus* are known only from three or four unassociated specimens, of which the leading specimen may be either an M$\underline{2}$ or an M$\underline{3}$. Also the principal specimen of *germanicus* (Melchingen) is an unerupted crown lacking the basal portion, and none of the specimens present the neck and roots. Moreover, the dimensions published by Harlé, Remane, and Hrdlička of the molars named above (M$\underline{1}$ or M$\underline{2}$) show considerable discrepancy, their breadth indices as given indicating different methods of measurement.

Nevertheless a careful comparison of the measurements, descriptions, figures, and casts, and of stereoscopic photographs by McGregor of the European *Dryopithecus* with the corresponding Indian teeth indicates the following differences between them:

Dryopithecus germanicus M$\underline{2}$

	ap.	tr.	br. ind.
Schlosser	10.7	11.3	105.6
Hrdlička	10.6	11.0	103.8
Cast	10.8	11.4	105.6

***Sivapithecus "darwini"* M$\underline{2}$**

	ap.	tr.	br. ind.
Glaessner	12.0	13.6	113.3

Sivapithecus sivalensis M$\underline{2}$

	ap.	tr.	br. ind.	
l. M$\underline{2}$	11.6	13.7	118	K 22/466
r. M$\underline{2}$	11.4	13.6	119	No. 617

Sivapithecus orientalis M$\underline{2}$

	ap.	tr.	br. ind.
Pilgrim	12.8	14.2	111
	12.7	15.5	122

From the measurements above it will be seen that the second upper molar of *Dryopithecus germanicus* has a decidedly lower breadth index than those of the Siwalik species referred to *Sivapithecus*, and that the second upper molar referred to *Dryopithecus darwini* is intermediate in this respect.

The principal "upper molar" (*Dryopithecus germanicus*) of the Tübingen collection compares favorably with $\mathrm{M}\underline{2}$ of our *Sivapithecus sivalensis* (No. 617) because neither shows any wear and the finest details of sculpture are still present. Consequently they are both in the first "stage of wear" as defined above. The differences are: in *D. germanicus* (1) the general contour is much more delicate; (2) the hypocone base is less protuberant posteriorly; (3) the opposite cusps (buccal and lingual) are less convergent; (4) all transverse ridges are sharper; the crista obliqua extends to the summit, while in *S. sivalensis* it goes only to the base of the protocone; (5) the secondary enamel wrinkles are more numerous and pronounced, the fovea posterior more sharply defined; (6) the ridge connecting the base of the protocone and the hypocone is more defined. In other words, *D. germanicus* is nearer to *Proconsul* and to the ancestral tritubercular tooth of all Primates.

The upper molar which was described by Depéret (1911, p. 33, figs. 1, 1*a*) from La Grive-Saint-Alban, but which he did not positively refer to *Dryopithecus fontani*, was regarded by him as a wisdom tooth ($\mathrm{M}\underline{3}$). One of us, however (M. H.), considers that the details of its crown, including the marked lingual projection of the hypocone and the labial projection of the paracone, are more favorable to the view that it is an $\mathrm{M}\underline{2}$, this in spite of the absence of a contact facet on its rear end, which is not always decisive evidence that a tooth is a last molar. In any case this tooth is much too small to belong to *Sivapithecus sivalensis*.

The relations of the respective ap. lengths of the first, second, and third lower molars to the sums of all three among Siwalik and European members of the *Dryopithecus* group are set forth in table 3.

TABLE 3—*Relative lengths (ap.) of* $\mathrm{M}\overline{1}$, $\mathrm{M}\overline{2}$, $\mathrm{M}\overline{3}$

	EUROPE			INDIA			
	$\frac{\mathrm{M}\overline{1}\text{ ap.} \times 100}{\mathrm{M}\overline{1}+\mathrm{M}\overline{2}+\mathrm{M}\overline{3}}$	$\frac{\mathrm{M}\overline{2}\text{ ap.} \times 100}{\mathrm{M}\overline{1}+\mathrm{M}\overline{2}+\mathrm{M}\overline{3}}$	$\frac{\mathrm{M}\overline{3}\text{ ap.} \times 100}{\mathrm{M}\overline{1}+\mathrm{M}\overline{2}+\mathrm{M}\overline{3}}$	$\frac{\mathrm{M}\overline{1}\text{ ap} \times 100}{\mathrm{M}\overline{1}+\mathrm{M}\overline{2}+\mathrm{M}\overline{3}}$	$\frac{\mathrm{M}\overline{2}\text{ ap.} \times 100}{\mathrm{M}\overline{1}+\mathrm{M}\overline{2}+\mathrm{M}\overline{3}}$	$\frac{\mathrm{M}\overline{3}\text{ ap.} \times 100}{\mathrm{M}\overline{1}+\mathrm{M}\overline{2}+\mathrm{M}\overline{3}}$	
Dryopithecus fontani (Gaudry, Harlé, Woodward)	29.0	36.0	35.0	26.7	32.3	38.2	.... *Sivapithecus sivalensis*
				29.5	34.6	35.9	.... *Dryopithecus frickæ*, type
				29.0	34.0	37.0	.... *Sivapithecus indicus*

From these measurements it will be seen that in these Siwalik species (especially in *Sivapithecus indicus*), $\mathrm{M}\overline{3}$ is relatively somewhat longer than in the European species.

The relative ap. lengths (given in percentages) of M$\overline{1}$+M$\overline{2}$ to the depth of the mandible between M$\overline{1}$ and M$\overline{2}$ are as follows:

	D. fontani	*S. sivalensis*	*S. frickæ*	*S. indicus*
Lartet	69	92.5 e	89	87
Gaudry	66			
Harlé	68			
Woodward	58			

In other words, these Indian forms have distinctly larger M$\overline{1}$+M$\overline{2}$ and less deep mandibles than their European relatives.

Sivapithecus indicus Pilgrim

(Plates 1, figures 9–12; 2, figure 2; 3, figure 1; 6; 7A, F, H)

Rec. Geol. Surv. India, vol. 40, 63, 1910; *ibid.*, vol. 45, 34, pl. I, figs. 7, 9, pl. II, figs. 1–3, 1915.

Sivapithecus himalayensis Pilgrim, Mem. Geol. Surv. India, n.s., vol. 14, 2–5, 1 pl., figs. 2, 2*a*, 2*b*, 1927.

Sivapithecus orientalis, Mem. Geol. Surv. India, n.s., vol. 14, 5–8, pl. I, figs. 1, 1*a*, 1927.

Geologic horizon—Nagri.

Specific characters (see table 4)—Lower molars of large size (M$\overline{1}$+M$\overline{3}$, 37.6; M$\overline{1}$+M$\overline{2}$, 26.9; M$\overline{1}$+M$\overline{2}$+M$\overline{3}$, 42.7); breadth indices of M$\overline{1}$, M$\overline{2}$, M$\overline{3}$ diminishing sharply posteriorly; M$\overline{1}$ with higher breadth index than in *sivalensis*, with moderate hypoconulid; M$\overline{2}$ with breadth index overlapped by that of *sivalensis*, hypoconulid larger and more lateral than in *sivalensis*, central fossa expanded anteroposteriorly, fovea posterior larger, not crossed by anteroposterior groove; M$\overline{3}$ not tapering posteriorly but broadly oval, with large hypoconulid; entoconid of moderate size. In the upper molars (see tables 1, 5) the breadth index rises but little from M$\underline{1}$ to M$\underline{2}$ and falls considerably in M$\underline{3}$; the anteroposterior dimension increases markedly from M$\underline{1}$ to M$\underline{2}$ and falls off slightly to M$\underline{3}$; M$\underline{3}$ with posterior cingulum more or less extended backward and heavily cuspidate; transverse ridge on metaconule intermediate to large and prominent.

TABLE 4—*Comparison of the lower molars of species of Sivapithecus*

	S. sivalensis		*S. frickæ*			*S. indicus*	
M$\overline{1}$+M$\overline{2}$+M$\overline{3}$	ap. 35.9		ap. 38.6			ap. 42.7	
M$\overline{1}$+M$\overline{3}$	36.3		38.8			37.6	
M$\overline{1}$+M$\overline{2}$	22.2		24.8			26.9	
M$\overline{1}$	10.6	tr. 9.5	11.5	tr. 10.5		11.8	tr. 10.9
	10.8	9.8				12.4	11.8
M$\overline{1}$ breadth index	90–91		91			92–95 e	
M$\overline{1}$ hypoconulid	Small		Moderate			Moderate	
M$\overline{2}$ (type)	ap. 11.6	tr. 11.4	ap. 13.3	tr. 12.3		ap. 15.1	tr. 14.2
					(13828)	14.5	13.7
M$\overline{2}$ breadth index	98.3		92.4			91–93	
M$\overline{2}$ hypoconulid	Small		Small			Better developed, more lateral	
Fovea posterior	Small, crossed by anteroposterior groove		Same as *S. sivalensis*			Expanded, anteroposterior groove absent	
M$\overline{3}$	ap. 13.7	tr. 12.3	ap. 13.8	tr. 12.7	(13828)	ap. 15.8	tr. 13.4
M$\overline{3}$ breadth index	90		92		(13828)	84.8	
M$\overline{3}$ hypoconulid	Well developed		Well developed			Well developed	
M$\overline{3}$ entoconid	Moderate		Small			Moderate	

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New Material—

Number	Horizon	Specimen	Measurements			Plate	Stage of wear
				ap.	tr.		
Y.P.M. 13828.....	Nagri	l. ramus with P$\overline{4}$–M$\overline{3}$					
			P$\overline{4}$	9.1	11.5	2, figs. 1*a*, 1*b*	IV
			M$\overline{1}$	12.4	11.8		III
			M$\overline{2}$	14.5	13.7		III
			M$\overline{3}$	15.8	13.6		III
616(Y.P.M. 13837)	(?)Nagri	l. P$\underline{3}$		8.9	11.3	1, figs. 10*a*, 10*b*	II
		l. P$\underline{4}$	(?)fragmentary				
		l. M$\underline{2}$		13.3	15.3	1, figs. 11*a*, 11*b*	II
613(Y.P.M. 13835)	Upper Chinji	r. M$\underline{2}$		12.7	15.5	1, fig. 12	
K 23/740	(?)Nagri	r. M$\underline{3}$		12.5	13.1	1, figs. 9*a*, 9*b*	
K 22/448	(?)Chinji	r. C$\underline{1}$		15	10.8	2, figs. 2*a*, 2*b*	
611	Upper Chinji	r. M$\overline{3}$		15	12+	3, fig. 7	

The foregoing material is of exceptional importance for several reasons. First, the finely preserved portion of a large left ramus (corpus) mandibulæ (Y.P.M. 13828, pl. 3, fig. 1; pl. 6) agrees so closely with Pilgrim's type of *Sivapithecus himalayensis* as to leave no substantial doubt as to specific identity. The second lower molar of this specimen also closely resembles Pilgrim's holotype lower molar (Ind. Mus. D 176) of *Sivapithecus indicus*, but not the M$\overline{2}$ of his subsequently chosen "type" mandible (Ind. Mus. D 177).

An isolated crown of M$\overline{3}$ (No. 611, pl. 3, fig. 7) from the upper Chinji lacks the bulbous basal portion of the crown and therefore presents a false appearance of narrowness (ap. 15, tr. 12+, ind. 80+). Its length is intermediate between those of *chinjiensis* (14.7) and *himalayensis* (15.8); the specimen probably belongs near to *Sivapithecus himalayensis* (= *indicus*).

One of the upper molars (K 23/740), which we also refer to *Sivapithecus indicus* (pl. 7D), appears to agree generically with the type of *Palæosimia rugosidens* Pilgrim (1915, pl. 2, fig. 9), but the differences in detail, together with the differences in horizon (Nagri as opposed to Chinji), may justify specific separation. This is fortunate because the type of *Palæosimia rugosidens* is but a single upper molar, whereas the type of *S. orientalis* is a much better specimen for specific comparison. More in detail, the third upper molar of *Sivapithecus himalayensis* agrees in general morphology with Pilgrim's holotype, M$\underline{3}$ of *Palæosimia rugosidens*, differing chiefly in the following points: (1) greater emphasis of the hypocone, which forms a more pronounced posterointernal angle; (2) lesser emphasis of metacone; (3) smaller conules on posterior cingulum; (4) lesser wrinkling of entire crown; (5) greater emphasis of groove between protoconule and protocone; (6) absence of accessory ridge between crista obliqua and posterior cingulum. In size, the type of *S. orientalis* is distinctly large. But these differences are here regarded as of possibly less than specific rank.

A well-preserved second upper molar (pl. 7F), No. 616 (Y.P.M. 13837), is close to M$\underline{2}$ of Pilgrim's type maxilla of *Sivapithecus orientalis*, but also occludes perfectly with M$\overline{2}$ of the type of *Dryopithecus frickæ*. Therefore *himalayensis* may prove to be a synonym of *frickæ*, but as the latter is from a later horizon (Dhok Pathan), we may provisionally leave them as distinct. Nevertheless this specimen is of some importance, since it aids in tying in the types of *frickæ* and *himalayensis* with the *Sivapithecus* series.

It will be noticed that *orientalis* is represented only by upper teeth and *himalayensis* by lower. Notwithstanding the fact that the type upper teeth of *orientalis* are definitely too small to fit on the type lower *himalayensis*, they yet fall within the limits of the same species, as Y.P.M. 13828 would occlude perfectly with a left maxilla of the type *orientalis*.

K 22/448, a massive right upper canine (pl. 2, fig. 2; pl. 7A, B, C), may be either a very large *sivalensis* or a smaller *indicus*.

From all this emerges the concept of a morphological sequence from *Sivapithecus sivalensis* to *S. indicus*. *S. frickæ* comes from a higher horizon (Dhok Pathan) but is nevertheless close to the main line. The modern orang is possibly an offshoot of this series. Further comparative measurements of the species referred to *Sivapithecus* are given in tables 5 and 6.

TABLE 5—*Comparison of upper molars referred to Sivapithecus*

	S. sivalensis				*S. indicus*			
M$\underline{1}$+M$\underline{3}$	32.2 (l.)				35.5 (r)			
M$\underline{1}$+M$\underline{2}$	21.5 (l.)				22.5 (r.)			
M$\underline{1}$	l.	ap. 10.7	tr. 12.2	ind. 114		ap. 11.0	tr. 12.0	ind. 109
	r.	10.5	12.2	113				
M$\underline{2}$	r.	11.4	13.6	119		12.8	14.2	111
	l.	11.6	13.7	118				
M$\underline{3}$	l.	11.0	13.0	118		12.4	13.2	105.5
					r.	12.5	13.1	104
M$\underline{3}$ post. cingulum	Slight				Heavily cuspidate and extended backward			
M$\underline{3}$ transv. ridge on metaconule	Slight				Intermediate to large and prominent			

TABLE 6—*Comparison of first and second upper molars of Dryopithecus and Sivapithecus*

	M$\underline{1}$				M$\underline{2}$		
	ap. pr to hy	tr. pr to pa	Index tr. × 100 / ap.		ap. pr to hy	tr. pr to pa	Index tr. × 100 / ap.
Dryopithecus germanicus (cast)	10.0	10.8	108		11.2	11.2	100
					10.8	11.0	101+
Sivapithecus sivalensis, No. 614	9.8	11.7	119				
				K 23/209	11.2	12.3	109
K 29/466	10.1	11.7	116		11.2	13.5	120
Sivapithecus indicus	10.0	12.8	128		11.5	15.1	131

From table 6 we see that in the first upper molar there is a marked increase in the transverse diameter (across the projecting paracone) both absolutely and relatively, as we pass from the primitive *Sivapithecus sivalensis* to the advanced *S. indicus*. In this regard the European *Dryopithecus germanicus* (in so far as it is represented by the best known specimen) lags considerably behind the Indian *Sivapithecus*. Similar differences are even more marked in the second upper molar.

"*Sivapithecus* (?) cf. *indicus*"

A single first right upper molar (No. 612, Y.P.M. 13834, pl. 1, figs. 13*a*–13*c*; pl. 5A, B, C), which is recorded from "Chinji, locality 96" by de Terra, is tentatively referred to this genus and species. It is but little worn and is superbly preserved. Its dimensions, ap. 11.3, tr. 12.4, ind. 109, closely approach those in $M\underline{1}$, the type of *Sivapithecus orientalis* Pilgrim (= *S. indicus*), but it differs markedly from that type in the sharp lingual cleft between the proto- and hypocone, the more brachyodont look of the whole crown, and the lesser convergence of its labial and lingual cusps toward the midline.

A curiously subhuman look is imparted to it by the incipient Carabelli cusp, the vestigial parastyle, the protoconule projecting on the mesial border, the foveæ anterior and posterior, and the general configuration of its cusps.

This tooth occludes well with the first and second lower molars of a cast of Ind. Mus. D 176, the mandible which was chosen by Pilgrim as the "type" of *Sivapithecus indicus* but which is nevertheless not the real holotype first designated by him, which is a second lower molar.

The second "type" of *Sivapithecus indicus* is an imperfect right ramus containing $P\overline{4}$, $M\overline{1}$, $M\overline{2}$. The second lower molar of this "*Sivapithecus indicus*" is much smaller than that of the type of *S. himalayensis* and has a greater breadth index and lower, more sharply convex cusps. Repeated comparisons of this cast with the types of *Dryopithecus cautleyi, D. frickæ*, and *S. himalayensis* suggest that the specimen belongs in the genus *Sivapithecus*, that it is a specialized offshoot beyond *sivalensis* and not far below *frickæ*, but not nearly as large as the true *indicus*.

To the same species we are also tentatively referring No. 615 (Y.P.M. 13831), a fragment of a right corpus mandibulæ containing the partly broken crowns of $M\overline{1}$ and $M\overline{2}$. So far as preserved, the fragment closely resembles the cast of the lower jaw of *Sivapithecus indicus* (Ind. Mus. D 177), especially in the low, strongly convex cusps, the position of the roots, the slight development and medial position of the hypoconulid of $M\overline{1}$, and the general proportions of the basal horizontal section of the neck of $M\overline{2}$.

As thus understood by us, "*Sivapithecus* cf. *indicus*" differs from the typical *S. indicus* in the sharp convexity and lowness of the cusps of the lower molars and in the "rounded squarish" rather than oblong plan of $M\overline{2}$. Nevertheless, so great is the range of individual variation in modern anthropoids that we are unwilling to propose a new specific name for these differences.

Sivapithecus (?) cf. darwini (Abel)

(Plate 3, figures 4, A)

Holotype—A third left lower molar loaned by the Prince of Wales College Museum, Jammu.

Geological horizon and locality—Dāl Sar, Ramnagar, Jammu, uppermost Chinji.

Specific characters—The third lower molar differs from that of *Sivapithecus himalayensis* in being notably shorter, with labially protruding cusp bases of protoconid and hypoconid; cusps convergent at top, as in *Sivapithecus indicus*; approaches $M\overline{3}$ of *S. sivalensis*, but notably shorter.

This specimen (pl. 3, figs. 4, A), while closely approaching the type $M\overline{3}$ of *Dryopithecus darwini* Abel, is from the upper Chinji (uppermost Miocene) and therefore somewhat younger than its European analogue, which is from Neudorf an der March (Czechoslovakia), a part of the "Vienna Basin," and is of Tortonian (upper middle Miocene) age.

This M$\overline{3}$ differs from the type of *Dryopithecus darwini* Abel in the following characters: (1) cusps higher, buccal and lingual cusps more convergent; this may be due in part to difference in wear; (2) cusp "7" (metastylid) less well defined; (3) outer cingulum even fainter than in *darwini*; (4) lingual stem of Y distinctly double.

The comparative measurements are as follows:

	Dryopithecus darwini, type (pl. 3, fig. 5)			M$\overline{3}$, Jammu		
(Abel)	ap. 13.5	tr. 11.8	br. ind. 87.4	ap. 13	tr. 12	br. ind. 92.3
Cast	13.5	12.4	92.6			

This M$\overline{3}$ is both too large and much too wide to fit in the empty alveolus of the M$\overline{3}$ type of *Sugrivapithecus salmontanus*.

If we arrange our third lower molars in series according to relative width, we have the breadth indices as follows:

Sugrivapithecus cf *gregoryi* (No. 607)	79.0
Dryopithecus cautleyi, type	90.0
Dryopithecus frickæ, type	92.0
"Jammu"	92.3
Dryopithecus darwini	87.4–92.6
Bramapithecus thorpei, type	95.0

In the talonid index Jammu M$\overline{3}$ is not far from *Bramapithecus thorpei*, but its trigonid index is lower and it is totally different in morphology.

In brief, this tooth is broadly oval, recalling that of *Bramapithecus thorpei*, but larger and not so short; in fact, it is intermediate in proportions and contour between *cautleyi* and *thorpei*.

Sivapithecus ?

Another specimen which may be tentatively referred to *Sivapithecus* is a second right upper molar (K 23/209) from the Kamlial formation pl. 7G; pl. 1, figs. 14*a*, 14*b*). This is of interest as being the oldest Siwalik anthropoid so far recorded. Unfortunately the surface of the crown has been weathered by grass roots, which have destroyed the finer details; the crown was also considerably worn. Its measurements, ap. 11.4, tr. 12.6, ind. 110, are somewhat larger than those of "*Dryopithecus punjabicus*" as recorded by Pilgrim, and somewhat smaller than those of *Sivapithecus sivalensis* (No. 617). In general appearance and details it seems nearer to the former (as figured by Pilgrim) than to the latter, from which it differs in its apparently lower crown. In another direction it compares well with the second upper molar of *Dryopithecus germanicus*, save for its larger size.

Bramapithecus cf. punjabicus (Pilgrim)

(Plate 3, figures 9, B)

To this species is tentatively referred a single right M$\overline{3}$ (609, Y.P.M. 13833, pl. 3, figs. 9, B) in the 1935 collection from the upper Chinji (ap. 13.7, tr. 11.9, br. ind. 86.1), in the third stage of wear (fig. 9). The talonid is relatively much narrower than in the type of *Dryopithecus punjabicus* and the whole tooth is larger; nevertheless the general appearance is strikingly similar: the steep flat lingual wall, the low relief of the occlusal surface, the conspicuous buccal pit, the presence of two accessory cuspules between the meta- and entoconids, the very low, unworn entoconid. As compared with *Sivapithecus sivalensis*, the present M$\overline{3}$ differs in the pronounced wrinkling of the enamel and the crenation of the lingual margin, the lesser relief of the main cusps, and the relative narrowness across the talonid.

On the other hand, this third lower molar, except for its marked posterior elongation, shows a strong resemblance to M$\overline{3}$ of the type of *Bramapithecus thorpei*, and the species *punjabicus* may indeed be partly intermediate in structure between the primitive *Sivapithecus sivalensis* and the highly specialized and short-jawed *Bramapithecus thorpei*; but rather than base a new genus upon a single third lower molar (which is a highly variable tooth), we refer the specimen under consideration (No. 609, Y.P.M. 13833), along with the species *"punjabicus,"* to the genus *Bramapithecus*.

Sugrivapithecus cf. salmontanus Lewis

(Plate 3, figures 2, C)

Preliminary notice of new man-like apes from India. Amer. Jour. Sci., vol. 27, 167–170, March 1934.

New Material—

Number	Horizon	Specimen	Measurements			Plate	Stage of wear
			ap.	tr.	ind.		
601..........	Upper Chinji	r. M$\overline{1}$	11.1	9.4	84.6	3, fig. 2	II–III
602..........	Upper Chinji	l. M$\overline{1}$	11.0	9.1	82.7	3, fig. 6	IV
610..........	Upper Chinji	l. M$\overline{1}$	10.0	9.5 (?)			IV–V

Discussion—The first lower molar (601, pl. 3, figs. 2, C) has the talonid as in *Sugrivapithecus salmontanus*, longer and wider in relation to the trigonid than in *Sivapithecus sivalensis*. The forward displacement of the hypoconid may have conditioned the oblique wear in contrast to the transverse wear in *Sivapithecus sivalensis*. The hypoconid, as in *Sugrivapithecus salmontanus*, is relatively large as compared with the protoconid, in contrast to *Sivapithecus sivalensis*. No. 602 is close to 601 but more worn. No. 610 has had the enamel chipped off its metaconid, thus changing dimensions and appearance.

Sugrivapithecus cf. gregoryi Lewis

(Plate 3, figures 8*a*, 8*b*, D)

A new species of *Sugrivapithecus*. Amer. Jour. Sci., vol. 31, 450, 451, June 1936.

New Material—No. 607 (Y.P.M. 13836), M$\overline{3}$ l., from the lower Chinji. Pl. 3, figs. 8*a*, 8*b*, D. Stage III. Ap. 12.8, tr. 10.2, ind. 79.

M$\overline{3}$ (No. 607) approaching type of *Neopithecus brancoi* (Schlosser) in triangular outline but much larger. Hypoconulid far extended posteriorly, imparting a triangular contour to the crown. Very low breadth index, reminiscent of *Dryopithecus sivalensis*, but trigonid relatively wider than talonid, talonid even narrower, and hypoconulid more tapering than in *D. sivalensis*. "Cusp 7" present with accessory stem to Y.

The surface of the crown (pl. 3D) has been damaged by erosion due to grass roots; this has given a false appearance of great wrinkling. The cusps are undoubtedly flatter than those of *Sivapithecus sivalensis* and reference to that genus is improbable. This tooth is widely different from the true *Dryopithecus* of Europe.

The much greater wear and erosion of No. 607 as compared with the type of *Sugrivapithecus salmontanus* conceals resemblance. Nevertheless, if placed in the empty alveolus the lingual curve of the tooth conforms to that of the alveolar border, and on the buccal side the three main cusps take much the same relations as do those of M$\overline{2}$. The extreme wear has flattened the transverse ridges of the metaconid, hypoconid, and hypoconulid. It is, however, probably too small for this species. It is not large enough to fit into the empty alveolus of *Sugrivapithecus salmontanus*; it is 2 mm. too short and much lower-crowned, and the cusps appear to be less swollen and convergent at the tips, possibly owing to the great wear of this tooth. It is, however, an M$\overline{3}$ of apparently just the right size and proportions to go with the known M$\overline{1}$ and M$\overline{2}$ of the type of *Sugrivapithecus gregoryi* Lewis, to which species we here refer it.

Ramapithecus cf. brevirostris (Lewis)

(Plates 2, figure 3; 8A–C)

Preliminary notice of new man-like apes from India. Amer. Jour. Sci., vol. 27, 162, March 1934.

New Material—No. 618, front part of mandible including right ramus (horizontal) with P$\overline{3}$–$\overline{4}$, M$\overline{1}$–$\overline{2}$, and alveoli of C$\overline{1}$, I$\overline{1}$–$\overline{2}$.

This specimen (pl. 2, fig. 3; pl. 8A–C) is important for several reasons. Allowing for differences of wear, it approaches in individual dimensions what may be expected in the hitherto unknown lower teeth of *Ramapithecus brevirostris* Lewis, but the teeth are somewhat too narrow and the P$\overline{3}$ has its long axis too anteroposteriorly oriented to fulfill completely the requirements of a lower dentition of the genotype. It differs in both stage and type of wear as compared with the holotype of *R. brevirostris.* It is not only a much older animal, but the lower cheek teeth are worn transversely into a nearly flat surface without projecting lingual cusps, whereas the holotype before mentioned leads one to expect that even in its greatly worn lower teeth the wear would have been more pronounced on the outer cusps than on the inner.

Nevertheless, the new ramus occludes quite well with the holotype of *R. brevirostris* and may well represent a member of this species entirely within the specific range of variation.

In the type palate all the teeth show a "morphological" approach to No. 617, *Sivapithecus sivalensis,* but are much smaller and are more worn. Both differ widely from *Dryopithecus germanicus* in markedly less posterior projection of the hypocone, with very small fovea posterior and less sharply defined transverse crests.

The remarkably small lower cheek teeth are narrower than those of *Bramapithecus thorpei,* but they have a breadth index higher than that of *Sugrivapithecus*; M$\overline{2}$ is markedly narrower than that of *Sivapithecus sivalensis.* The specimen is important because it carries the lower border of the mandible to and beyond the midline and thus affords data for reconstructing the opposite side. The jaw is much deeper in the symphyseal region than beneath the molars. The symphyseal region approaches that of *Sugrivapithecus salmontanus,* but lacks a lingual torus even though very old.

More in detail, the body of the mandible is deep and thin and there is a small but sharply defined geniohyoid fossa on the lower border on either side of the interdigastric spine; there is hardly any mental eminence. The pit for the genioglossal muscles is very shallow. Thus the present symphyseal region differs widely from that of *Sivapithecus sivalensis*, especially in its lack of emphasis of the lingual torus and in the delicacy of the lower border.

DISCUSSION AND SUMMARY

In previous papers several species of Indian fossil anthropoids have been tentatively referred to the genus *Dryopithecus*, although in the paper on the dentition of that genus (1926) two of us suggested that the Indian forms were more advanced than the typical *Dryopithecus fontani* of Europe and probably deserved separate generic rank. The additional material now available further emphasizes the contrast in dimensions of the lower molars between *Dryopithecus fontani* and *Sivapithecus sivalensis* and other Indian species. The comparative measurements also show that the depth of the mandible between $M\overline{1}$ and $M\overline{2}$ is relatively greater in the European than in the Siwalik members of the "*Dryopithecus*" group.

The most primitive known upper molars of the "*Dryopithecus*" group are probably those of *Proconsul africanus*, as described by Hopwood. These retain a good many of the still older tarsioid features, which are clearly exemplified in the Middle Eocene *Periconodon helveticus* Stehlin (1916) and of which traces evidently persist in *Proconsul*. The latter, however, as befits its far more recent age (?Lower Miocene), has advanced beyond *Periconodon* and toward the *Dryopithecus* pattern of the upper molars in the following respects: (1) the size as a whole is several times greater; (2) the interdental triangular embrasures are almost eliminated; (3) the hypocones of $M\underline{1}$, $M\underline{2}$ have become large and now project posteriorly, especially in $M\underline{2}$; (4) the narrow valley between the crista obliqua (connecting the proto- and metacones) and the posterior cingulum has become constricted, giving rise to the fovea posterior; (5) the parastyle at the anteroexternal corner of the tooth has virtually disappeared, leaving only the outer end of the anterior cingulum; (6) the external cingulum has virtually disappeared, but the internal cingulum is still well defined.

In *Sivapithecus* the four main cusps of the first and second upper molars have become swollen and the crown as a whole is higher, the cusps blunter, the cingula have disappeared, and the crista obliqua is less prominent. In the third upper molar the hypocone and posterior rim have become much larger and more prominent. The orang and *Gigantopithecus* carry these specializations still farther.

The body of the mandible among recent anthropoids is vertically shallow in the gibbons and their allies, while that of the orangs is very deep. Likewise among fossil apes the mandible of *Dryopithecus fontani* is very deep, while that of *Bramapithecus thorpei* is quite shallow. In *Sivapithecus* the mandible is relatively shallower than in the true *Dryopithecus* of Europe.

The wide differences in this measurement may be partly sexual, as Weidenreich (1936, pl. XI) has recently shown in the mandibles of *Sinanthropus*. There are also wide differences in respect to the degree of thickness of the body of the mandible: this in the type of *Dryopithecus frickæ* is remarkably robust, in *Ramapithecus* cf. *brevirostris* very thin.

The symphyseal region of the mandible is fully known in only a few forms (*Dryopithecus fontani, Sivapithecus sivalensis, Ramapithecus* cf. *brevirostris*), but the range of structural variation approximates that of recent anthropoids.

The lower dental arch of *Sivapithecus*, so far as we have been able to reconstruct it, may be nearly matched in form among recent orangs. The lower dental arches of several of the other Siwalik genera will be discussed by Lewis in his forthcoming memoir.

The crowns of the lower incisors in *Dryopithecus fontani*, as figured by Gaudry, were transversely narrower than those of recent apes (except the gibbons). They were indeed more like those of *Pliopithecus* and thus presumably more primitive. The lower incisors of some Indian anthropoids, although known only from their roots and alveoli, may have had somewhat wider crowns than those of the European *Dryopithecus fontani*, because the lower molars, at least in *Sivapithecus*, are distinctly progressive toward the modern orang type. Very little is known of the crowns of the upper incisors, but in *Sivapithecus sivalensis* and *Ramapithecus brevirostris* they were apparently narrower transversely than in modern anthropoids.

As to the upper canine tooth, the apparently most primitive known anthropoid type is that of the East African, lower Miocene genus *Proconsul*, as described by Hopwood. This is characterized by a nearly straight vertical tapering crown, deeply grooved in front, with an incipient internal cingulum and basal tubercle; the bladelike posterior edge cooperates with the high pointed buccal cusp of the anterior premolar to produce a combination of blade and notch, which recalls the conditions in the carnassial teeth of recent carnivores. In modern male gorillas, the posterior portion of the upper canine crown almost forms a second lobe, separated by a basal groove from the anterior portion—a very specialized condition.

In certain female orangs the upper canines have short crowns and in several ways suggest deciduous upper canines. The upper canines of the Indian anthropoids vary from an almost premolar-like crown, in the supposed female *Sivapithecus sivalensis*, to a large dagger-like crown, in the male type of *Sivapithecus orientalis*. The lower canines are relatively wider in the labio-lingual diameter than the upper canines and the height of the lower canine crown is usually less than that of the upper.

The possession of large male canines and obliquely sloping anteroexternal faces on the lower anterior premolars are characteristically anthropoid characters, which are doubtless overemphasized in some modern anthropoids. We follow Remane (1927) and Woodward (1914) in supposing the "feminized" form of the upper canines in man, together with the lack of an oblique anteroexternal face on his anterior lower premolar, to be entirely secondary features, early acquired (and showing already even in *Sinanthropus*) but nevertheless secondary.

The crown of the anterior lower premolar varies from a laterally compressed, almost secant form (associated with the shearlike blade of the upper canine) to an obliquely placed, more oval, almost bicuspid form. Similar differences may be seen in modern anthropoids.

The posterior lower premolar varies but little, chiefly in the degree of development of the talonid.

The upper premolars, both anterior and posterior, have become completely bicuspid, as in modern apes. The anterior usually differs from the posterior premolar in that the inner (lingual) cusp is relatively much lower and the outer higher, while in the posterior premolar the two main cusps are almost equal, the anterior premolar ($\mathrm{P}\underline{3}$ of the primitive placental dentition) having a high pointed labial cusp which cooperates with the posterior (distal) blade of the canine to produce a sharp jag or notch analogous to that seen in the carnassial teeth of the dentition of carnivores. *Ramapithecus*, however, is an exception to this rule, since its anterior upper premolar is in a relatively advanced stage. The inner lobe of both the upper premolars is bordered by two parallel transverse ridges.

The lower molars vary widely, from the long narrow crowns of *Sugrivapithecus gregoryi* (pl. 8E, breadth index of $\mathrm{M}\overline{2}$, 76.7) to the very broad crowns of *Bramapithecus thorpei* (pl. 8D, index, 106). The several elements of the molar crown vary widely in position, height, etc., thus producing corresponding differences in the details of the general "*Dryopithecus* pattern." Formerly minor surface features of the lower molar crowns have frequently been used as specific characters. Our review of the material shows, however, that these minor features are often merely due to the degree of wear.

The most variable tooth, both in proportions and in dimensions, is the third lower molar, which is relatively very large in the type of *Sivapithecus himalayensis* and very small in the type of *Bramapithecus ? sivalensis* Lewis, very short and relatively wide in *Bramapithecus thorpei*, exceedingly narrow in *Sugrivapithecus* cf. *gregoryi*. If we may judge by the excessively wide variability of $\mathrm{M}\overline{3}$ in recent anthropoids and man, the variations of this tooth in Siwalik anthropoids may eventually prove to be of minor systematic value. But in this question as in so many others, the great need is for "more fossils and always more fossils."

With regard to the general construction of the jaws and teeth the Siwalik anthropoids, taken as a whole, were on a distinctly infrahuman grade of evolution. But in particular features, now one and now another approaches or even overlaps the outer zone of human variations. For example, the lower second and third molars of *Bramapithecus thorpei* Lewis in respect to the breadth indices even surpass some human teeth; and in earlier papers it has been shown (Gregory, 1916; Gregory and Hellman, 1926) that the lower molars of Siwalik anthropoids also exhibit many minor variations of what we have called the "*Dryopithecus* pattern" of the lower molars, especially in $\overline{M2}$, which has been preserved more fully in recent anthropoids, less clearly in known fossil and recent Hominidæ.

In closing, we deem it important to emphasize the following facts: (1) that the extinct anthropoid apes ranged over an enormous area in the eastern hemisphere—from Spain in the west to India and China in the east, and southward from Egypt to South Africa; (2) that the group as a whole was exceedingly variable, at least in the details of the jaws and dentition; (3) that while the Siwalik genus *Ramapithecus* and the South African *Australopithecus* were still simians by definition, they were almost at the human threshold, at least in respect to their known anatomical characteristics.

Nor can we find any convincing evidence that the peculiar features of the teeth of *Sinanthropus* and later hominids (such as irregular folds and wrinkles of the enamel surface of the molars, taurodontism of the molars, the shovel-shaped form of the central upper incisors, the lowness and bluntness of the canines, etc.) are ever anything more than specializations, of later date than the opposite characters found in the upper Tertiary anthropoids of the Siwaliks.

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PLATE 1

Sivapithecus sivalensis

FIG. 1—*a*. Left C$\underline{1}$. K 29/466. Occlusal view
b. Left C$\underline{1}$. K 29/466. Anterior view
c. Left C$\underline{1}$. K 29/466. Labial view
d. Left C$\underline{1}$. K 29/466. Lingual view
e. Left C$\underline{1}$. K 29/466. Posterior view
FIG. 2—*a*. Left P$\underline{3}$. No. 617. Occlusal view
b. Left P$\underline{3}$. No. 617. Anterior view
FIG. 3—*a*. Left P$\underline{4}$. K 29/466. Occlusal view
b. Left P$\underline{4}$. K 29/466. Anterior view
FIG. 4—*a*. Left M$\underline{1}$. No. 617. Occlusal view
b. Left M$\underline{1}$. No. 617. Anterior view
FIG. 5—*a*. Left M$\underline{2}$. K 29/466. Occlusal view
b. Left M$\underline{2}$. K 29/466. Anterior view
FIG. 6— Left M$\underline{3}$. No. 617. Occlusal view
FIG. 7—*a*. Right M$\underline{1}$. K 29/466. Occlusal view
b. Right M$\underline{1}$. K 29/466. Anterior view
FIG. 8—*a*. Right M$\underline{2}$. No. 617. Occlusal view
b. Right M$\underline{2}$. No. 617. Anterior view

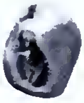
Sivapithecus indicus

FIG. 9—*a*. Right M$\underline{3}$. K 23/740. Occlusal view
b. Right M$\underline{3}$. K 23/740. Posterior view
FIG. 10—*a*. Left P$\underline{3}$. No. 616 (Y.P.M. 13837). Occlusal view
b. Left P$\underline{3}$. No. 616 (Y.P.M. 13837). Anterior view
FIG. 11—*a*. Left M$\underline{2}$. No. 616 (Y.P.M. 13837). Occlusal view
b. Left M2. No. 616 (Y.P.M. 13837). Posterior view
FIG. 12— Right M$\underline{2}$. No. 613 (Y.P.M. 13835). Occlusal view

FIG. 13—"*Sivapithecus indicus*"
a. Right M$\underline{1}$. No. 612 (Y.P.M. 13834). Occlusal view
b. Right M$\underline{1}$. No. 612 (Y.P.M. 13834). Anterior view
c. Right M$\underline{1}$. No. 612 (Y.P.M. 13834). Lingual view

FIG. 14—*Bramapithecus* cf. *punjabicus*
a. Right M$\underline{2}$. K 23/209. Occlusal view
b. Right M$\underline{2}$. K 23/209. Posterior view

FIG. 15—*Pongo pygmæus* (Orang)
a. Right C$\underline{1}$. Y.P.M. 0-2585. Lingual view
b. Right C$\underline{1}$. Y.P.M. 0-2585. Posterior view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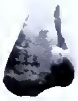
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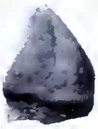
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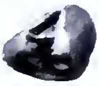
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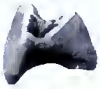
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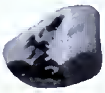
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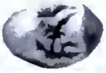
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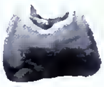
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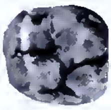
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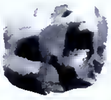
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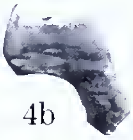
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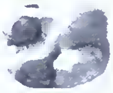
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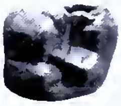
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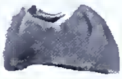
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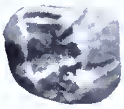
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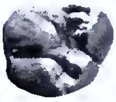
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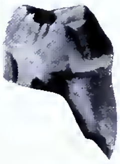
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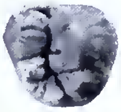
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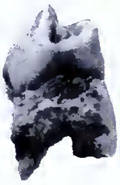
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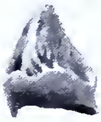
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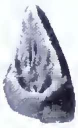
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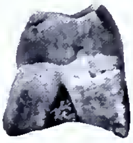
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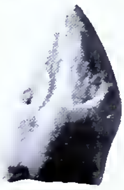
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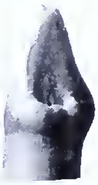
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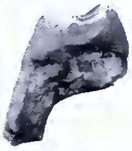
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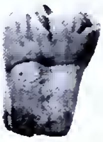
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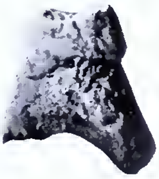
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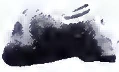
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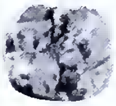
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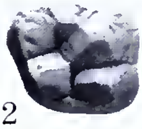
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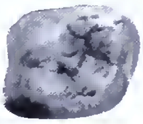
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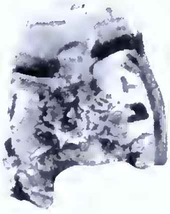
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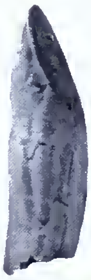
PLATE 2

FIG. 1. ?*Sivapithecus sivalensis*
a. Left C$\underline{1}$. K 23/212. Anterior view
b. Left C$\underline{1}$. K 23/212. Lingual view
FIG. 2. *Sivapithecus indicus*
a. Right C1. K 22/118. Anterior view
b. Right C1. K 22/118. Lingual view
FIG. 3. *Ramapithecus* cf. *brevirostris*
a. Right ramus. No. 618. Occlusal view
b. Right ramus. No. 618. Labial view
c. Right ramus. No. 618. Anterior view
d. Right ramus. No. 618. Posterior view

Sivapithecus sivalensis. Upper canines. *Circa* 2/1. A, B: K 23/212, Chinji; labial and anterior views. C, D, E: K 29/466, Nagri; "premolariform" canines, labial, crown, and lingual views.



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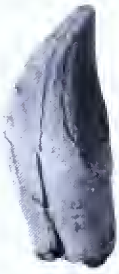

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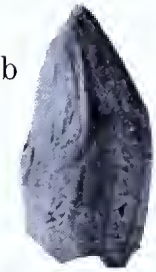

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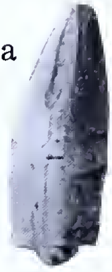

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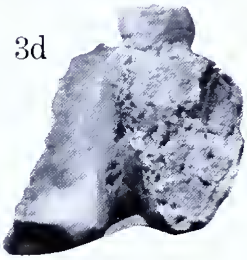

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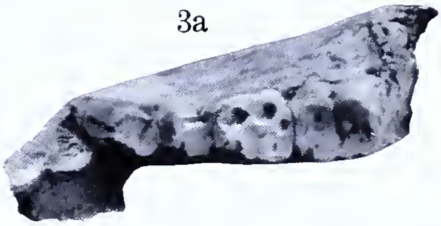

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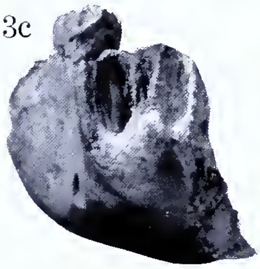

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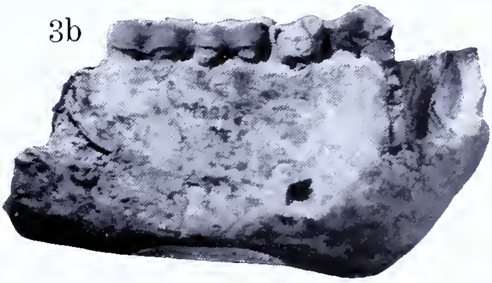

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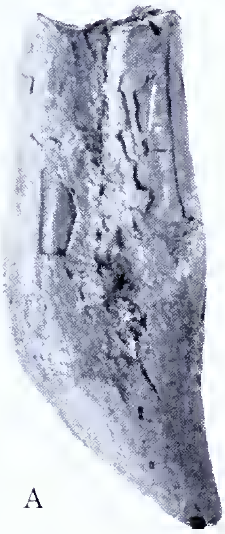

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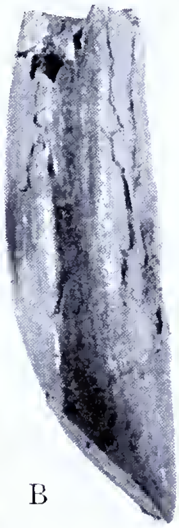

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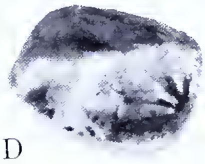

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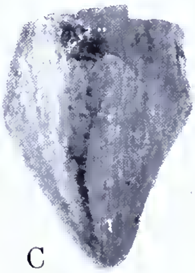

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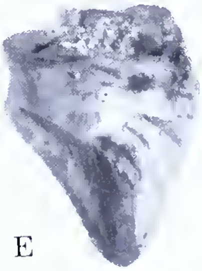


E

PLATE 3

FIG. 1 *Sivapithecus indicus*

a. Left ramus. Y.P.M. 13828. Occlusal view

b. Left ramus. Y.P.M. 13828. Labial view

FIG. 2 *Sugrivapithecus salmontanus*

a. Right M$\bar{1}$. No. 601. Occlusal view

b. Right M1. No. 601. Labial view

FIG. 3 *Sivapithecus sivalensis*

a. Right M2. No. 600 (Y.P.M. 13832). Occlusal view

b. Right M2. No. 600 (Y.P.M. 13832). Labial view

FIG. 4—*Sivapithecus* cf. *darwini*

a. Left M3. Jammu loan. Occlusal view

b. Left M3. Jammu loan. Posterior view

FIG. 5 *Dryopithecus darwini*

a. Left M3. Cast of type. Occlusal view

b. Left M3. Cast of type. Posterior view

FIG. 6 *Sugrivapithecus salmontanus*

Left M1. No. 602. Occlusal view

FIG. 7 *Sivapithecus* cf. *indicus*

Right M$\bar{3}$. No. 611. Occlusal view

FIG. 8 *Sugrivapithecus gregoryi*

a. Left M3. No. 607 (Y.P.M. 13836). Occlusal view

b. Left M3. No. 607 (Y.P.M. 13836). Labial view

FIG. 9 *Bramapithecus* cf. *punjabicus*

a. Right M$\bar{3}$. No. 609 (Y.P.M. 13833). Occlusal view

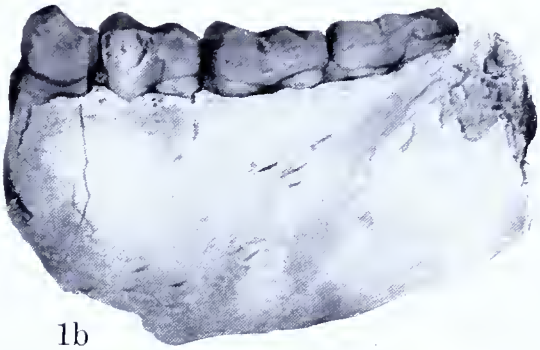
b. Right M3. No. 699 (Y.P.M. 13833). Labial view

A. *Sivapithecus* cf. *darwini*. Third left lower molar, "Jammu," upper Chinji. × 2

B. *Bramapithecus* cf. *punjabicus*. Third right lower molar, No. 699 (Y.P.M. 13833), upper Chinji. × 2

C. *Sugrivapithecus* cf. *salmontanus*. Right first lower molar, No. 601, upper Chinji × 2

D. *Sugrivapithecus* cf. *gregoryi*. Third left lower molar, No. 607, lower Chinji. × 2.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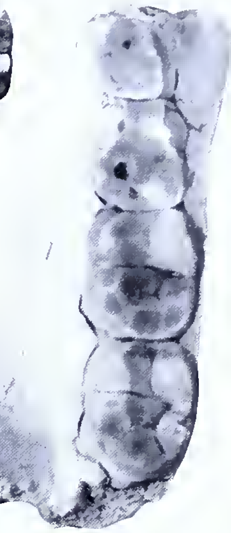
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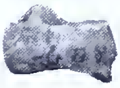
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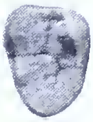
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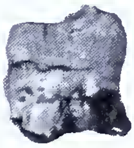
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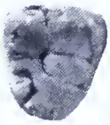
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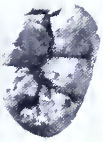
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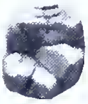
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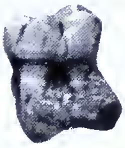
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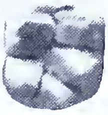
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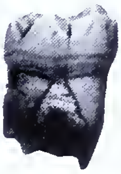
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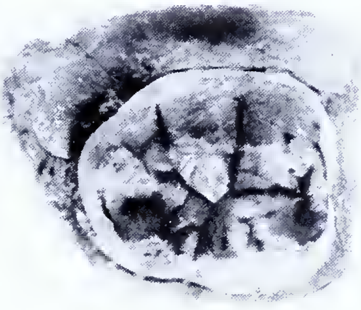
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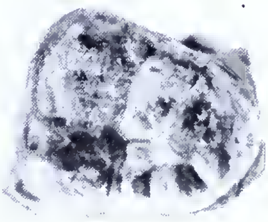
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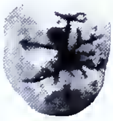
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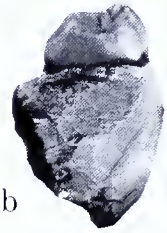
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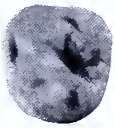
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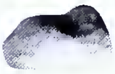
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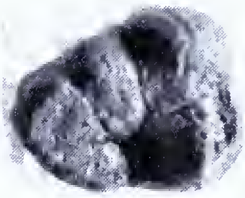
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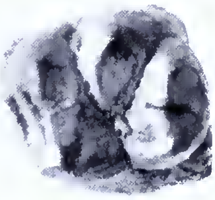
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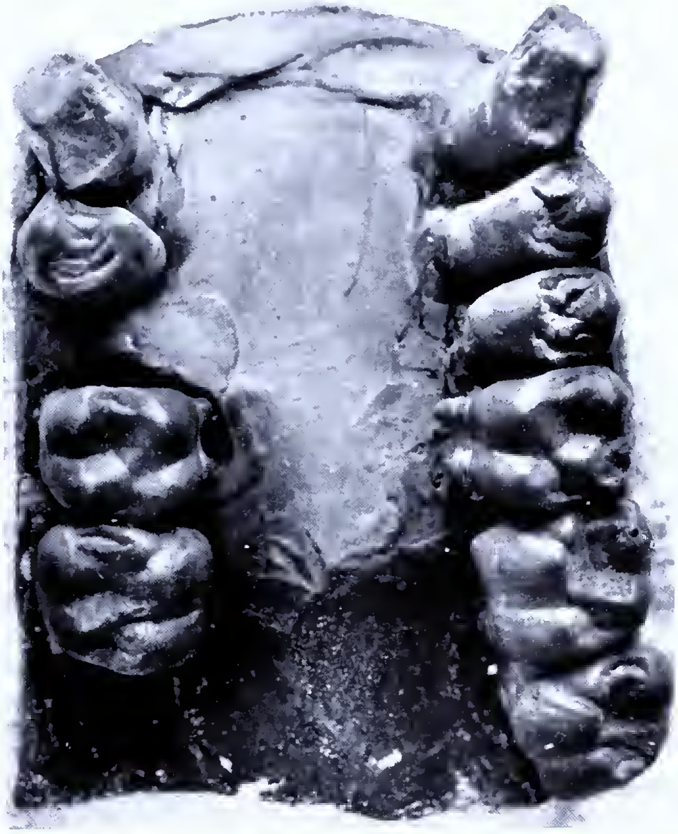
PLATE I

Sivapithecus sivalensis (Lydekker). A, upper teeth, Nos. 617 and K 29 466, all belonging to one individual. B, C, reconstruction of palatal (B) and mandibular (C) arches by Milo Hellman. All natural size.



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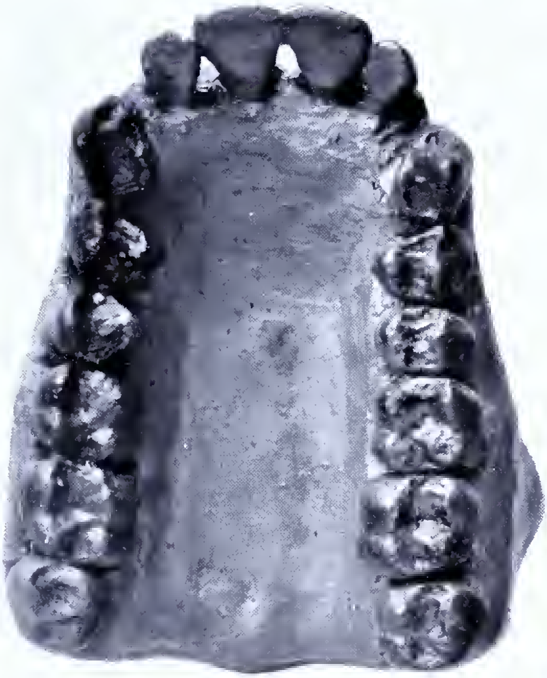

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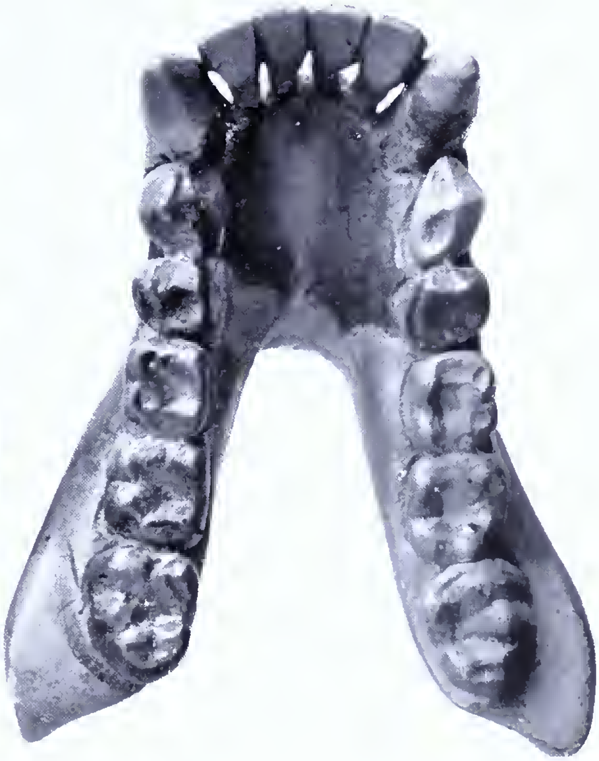
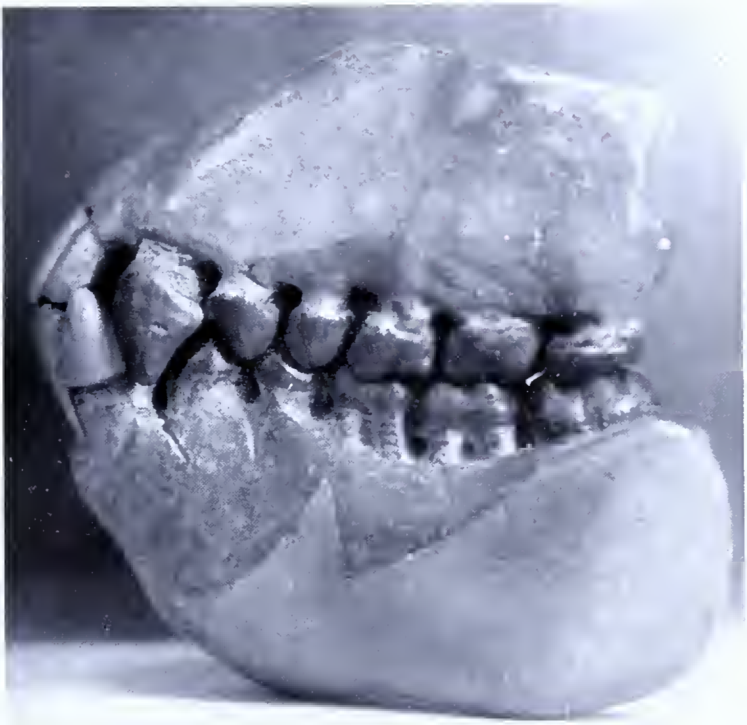


C

Plate 5

A. *Sivapithecus sivalensis.* Reconstruction of upper and lower jaws in occlusion. Natural size.

B, C, "*Sivapithecus* cf. *indicus.*" First right upper molar, No. 612 (Y.P.M. 13831). Chinji. × 2. B, crown view. C, lingual side showing incipient "Carabelli cusp."



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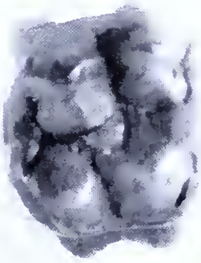

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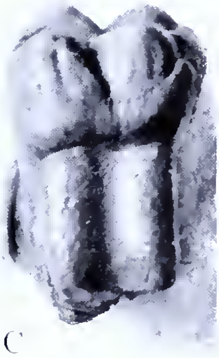


C

Plate 6

Sivapithecus indicus. Left corpus mandibulæ, with $P\overline{4}$–$M\overline{3}$. Y.P.M. 13828, Nagri. × 3/2. A, outer, B, inner, C, top view.

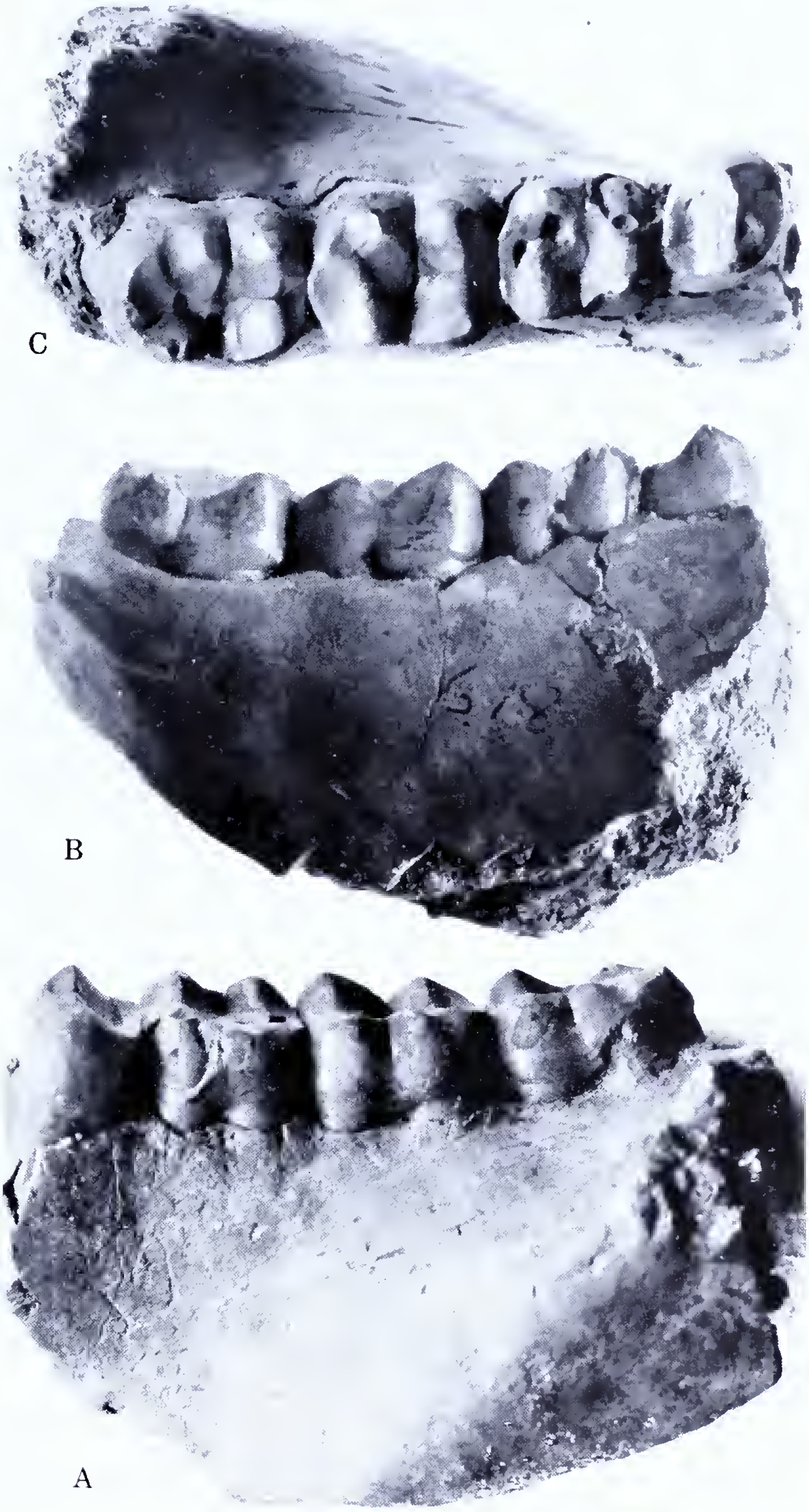

C
B
A

Plate 7

Sivapithecus indicus. All × 2.

A, B, C, right upper canine, K 22/118, (?)Chinji; labial, anterior, and lingual views.
D, right M3, K 23/710, (?)Nagri; crown view.
E, right M2, No. 613 (Y.P.M. 13835), upper Chinji.
F, left M2, No. 616 (Y.P.M. 13837), (?)Nagri; crown view.
G, right M2, K 23/209, Kundal, ?*Sivapithecus*; crown view.
H, I, left P3, No. 616 (Y.P.M. 13837), *Sivapithecus indicus*, posterior and crown views.

PLATE 7

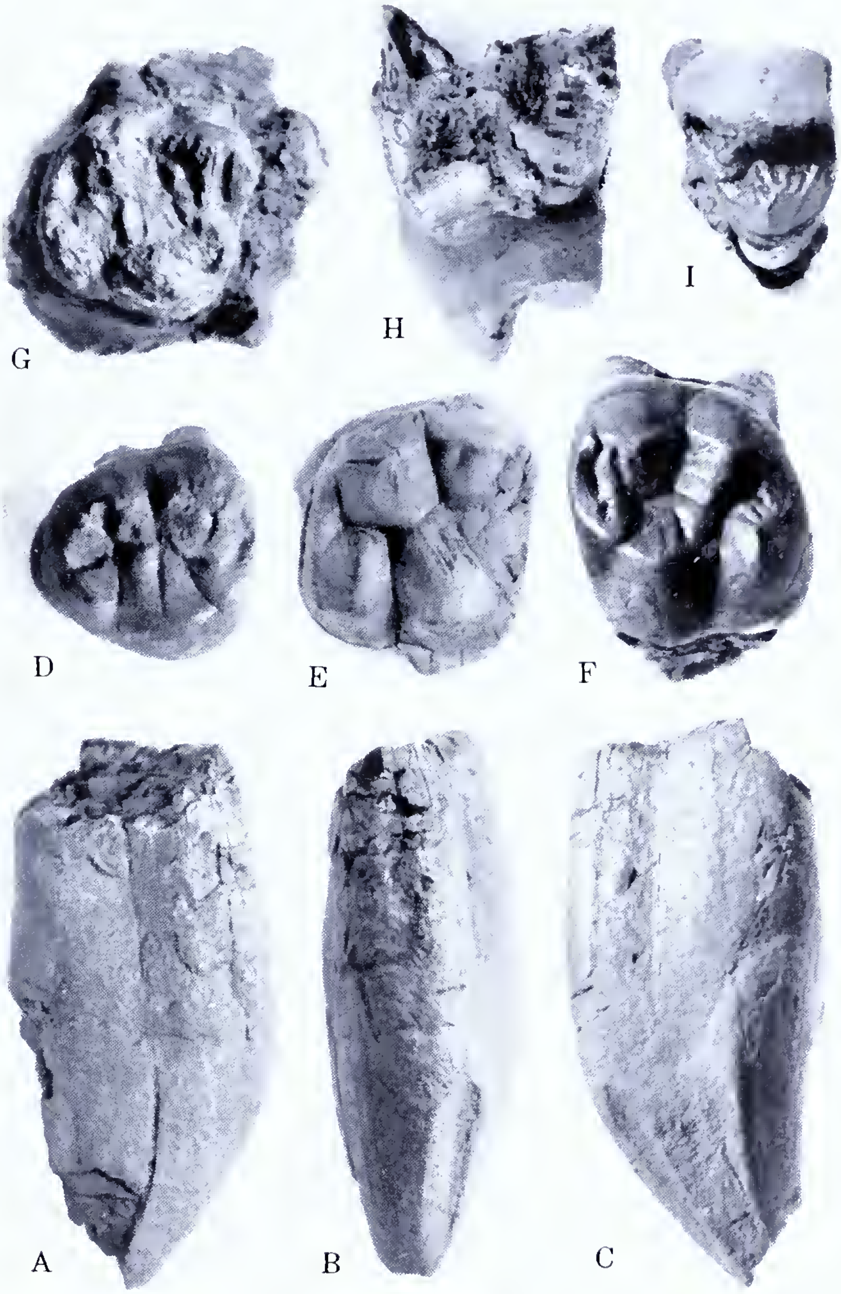
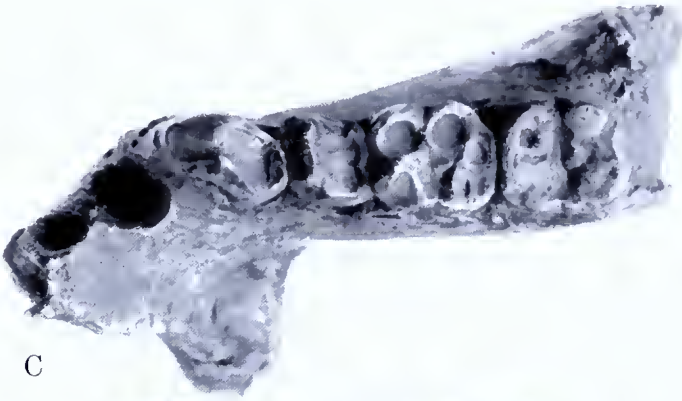


PLATE 8

Ramapithecus cf. *brevirostris*. Right corpus mandibulae No. 618, upper Chinji. × 3/2
A, outer, B, inner, C, crown view.

Contrasting proportions of the lower molars in two species of Siwalik anthropoids
D, *Bramapithecus thorpei* Lewis; E, *Sugrivapithecus gregoryi* Lewis.



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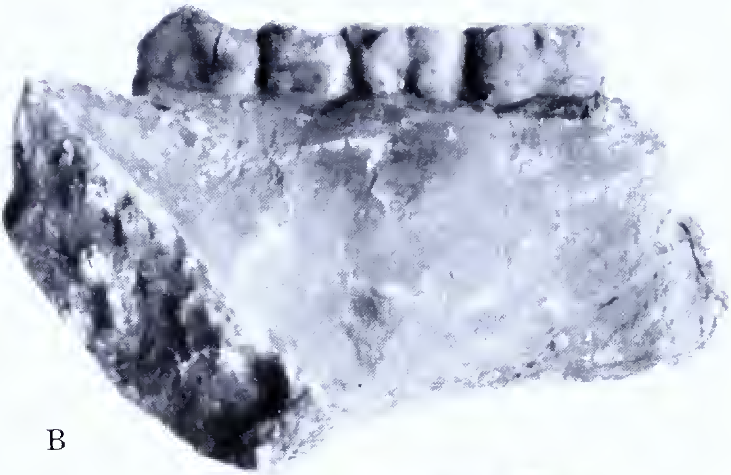

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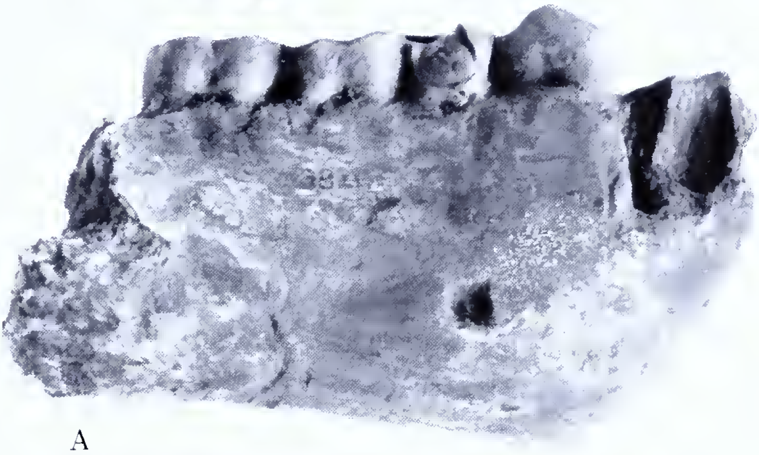

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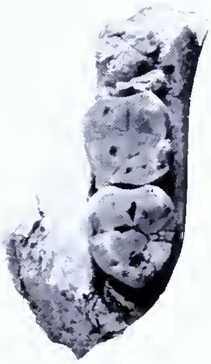

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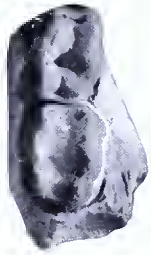

E

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